DOCUMENT RESUME

ED 218 816 EC 142 755

AUTHOR	Guess, Doug; And Others
TITLE	Quantitative Assessment of Motor and Sensory/Motor Acquisition in Handicapped and Nonhandicapped Infants and Young Children. Volume II: Interobserver Reliability Results for the Procedures.
INSTITUTION	Kansas Univ., Lawrence. Early Childhood Inst.
SPONS AGENCY	Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
REPORT NO	ECI-154
PUB DATE	Apr 81
CONTRACT	300-77-0308
NOTE	472p.; For related document, see EC 142 754 and ED 217 668.
AVAILABLE FROM	Kansas University, Early Childhood Institute, Document Reprint Service, Haworth Hall, Lawrence, KS 66045 (no price quoted).
EDRS PRICE	MF01/PC19 Plus Postage.
DESCRIPTORS	Developmental Stages; *Evaluation Methods; Infants; *Motor Development; *Multiple Disabilities; *Perceptual Motor Learning; *Severe Disabilities; *Test Reliability; Young Children

ABSTRACT

The second of a three volume report on a University of Kansas approach to developing quantitative measures of motor and perceptual motor functioning in nonhandicapped and severely/multiply handicapped infants and young children presents interobserver reliability results from the measures described in volume 1. Some studies also include a limited amount of performance data. Studies address assessment of the following functions: visual fixation, visual tracking, visual scanning, reach behavior, grasp behavior, transfer behavior, release, sitting behavior, head control, crawling and creeping, standing and sitting, and standing and walking. (CL)

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QUANTITATIVE ASSESSMENT OF MOTOR AND SENSORY/MOTOR ACQUISITION IN HANDICAPPED AND NONHANDICAPPED INFANTS AND YOUNG CHILDREN

VOLUME II

Interobserver Reliability Results for the Procedures[1]

By

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April, 1981

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[1] The material in this document was supported, in large part, by the Early Childhood Institute (a grant from the Bureau of Education for the Handicapped--USOE 300-77-0308) at the University of Kansas.

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INTRODUCTION

An earlier document, *Quantitative Assessment of Motor and Sensory/ Motor Acquisition in Handicapped and Nonhandicapped Infants and Young Children (Volume I): Assessment Procedures for Selected Developmental Milestones*, presented quantitative procedures for measuring motor and and sensory/motor acquisition among handicaped and nonhandicapped infants and young children. This volume was distributed as ECI Document No. 135 in April, 1980.

The present Volume II contains interobserver reliability results from the quantitative measurement procedures described in the first volume. Some of the studies also include a limited amount of performance data that were collected in conjunction with the reliability data. The order in which the reliability data are presented corresponds to the areas of assessment for the selected "developmental milestones" presented in Volume I, and the same page numbering system is used.

Originally, we had planned to also include in this Volume II the replication studies for the procedures. However, not all of the replication studies are completed at this time, and the number of pages for this volume has exceeded our original estimates. Accordingly, the replication studies will be presented as Volume III, and the studies pertaining to the application of the procedures will be contained in a fourth volume.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE VISUAL FIXATION AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped and Three Handicapped Children[1]

by

Rhonda Eye

and

Cynthia M. Janssen

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[1] The proceudres and data reported in this study were taken from a Master's thesis by Rhonda Eye that was submitted to the Department of Special Education, University of Kansas, in May, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in Pages VO(F) 1 to VO(F) 13 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to measure the frequency, duration, and mean duration of visual fixations of preferred objects when the child was in a sitting, prone, and sidelying position. Visual fixation was considered to occur when the student's eyes were directed toward the stimulus for at least one second. A 3' x 3' plexiglass grid, divided into nine sections, was used to determine placement for presentation of stimulus items: centered directly in front of child, right of center, left of center, centered up from child, up to the right, up to the left, centered down from child, down to the right, and down to the left. Fixation on objects in each of these grid positions was tested at two distances from the child: grid 6"-12" from child and grid 18"-24" from child.

For each trial the grid was placed directly in front of the child with the examiner directly in front of the child and grid in order to clearly view the child's eyes. A trial began when the stimulus object was presented and the student was instructed to look and ended after 15 seconds had elapsed. The frequency and cummulative duration of visual fixations with the stimulus object was recorded. Each student was tested in at least two positions with four observation sessions per position.

Subjects

This study included both school age multiply handicapped children and one nonhandicapped infant. The three multiply handicapped subjects were selected from a special education classroom from severely multiply handicapped students. Subjects were selected based on the criterion of having some visual fixation behavior.

Subject 1. Larry was a 15 year old male. He was nonambulatory and had nystagmus. According to the Callier-Azusa Scale (Stillman, 1978), he was functioning at approximately a 44 month level visually and at a 24 month level for visual-motor skills.

Subject 2. Paul was a 12 year old male. He was ambulatory and diagnosed as emotionally disturbed. According to the Callier-Azusa Scale (Stillman, 1978), he was functioning at a 48 month level visually and at approximately a 28 month level for visual-motor skills.

Subject 3. Bill was a 14 year old male. He was nonambulatory and athetoid. According to the Callier-Azusa Scale (Stillman, 1978), he was functioning at an 18 month level visually and at a 12 month level for visual-motor skills.

Subject 4. Lee was a normally developing male who was observed from four to eight weeks of age.

Procedures for Obtaining Measures of Reliability

Reliability was recorded and computed in the same manner for each position where visual fixation was measured. Two examiners were positioned directly in front of the child and the grid as close to one another as possible so each could clearly view the child's face from approximately the same angle. Each examiner recorded the cumulative duration and number of fixations for each trial. When the trial had begun, the two examiners observed only the child. They did not look at or talk to one another. During a trial neither examiner attended to the other's stopwatch. Upon completion of a trial each examiner recorded the total duration of visual fixation behavior and the number of fixations on the data sheet. Mean duration was then computed by dividing the total duration of fixations by the frequency of fixations. Upon completion of a session reliability was determined for each trial and for the total session. Reliability was computed according to the following formula:

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements + disagreements}}$$

Each trial was conducted twice with various time intervals between sessions. Two sets of two examiners recorded data for each trial. Therefore, there were four sets of reliability data recorded for each trial.

Results

This section presents interobserver reliability data for the four subjects and positions (sitting, prone and/or sidelying) in which visual fixations were measured. Interobserver reliability data are presented for mean frequency of fixations and mean duration of fixations. Grid section, subject position and grid distance are considered. All scores were computed to two decimal points and rounded to the nearest whole number. Performance data for mean duration of fixations is also presented. All scores for mean duration were computed to the nearest tenth of a second and rounded to the nearest one-half second.

Subject 1. The mean reliability scores of frequency of fixations over four observations in three positions are presented in Table 1. These scores were obtained by recording the number of fixations during the 15 second trial interval. The mean reliability scores for the near distance ranged from 92% to 100% with a mean score of 99% in the sitting position; 87% to 100% with the mean socre of 99% in the prone position; and 87% to

Table 1

Mean Reliability Scores of Four Observations for Frequency of Visual Fixation for Subject 1

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	100%	100%	100%	100%	100%	100%	100%
B	92%	100%	100%	100%	100%	100%	99%
C	100%	100%	100%	100%	75%	87%	94%
D	100%	100%	87%	100%	100%	100%	98%
E	100%	100%	100%	87%	100%	100%	98%
F	100%	100%	100%	87%	87%	100%	96%
G	100%	92%	100%	100%	100%	100%	99%
H	100%	100%	100%	100%	100%	100%	100%
I	100%	100%	100%	100%	100%	100%	100%
Total Mean Reliability	99%	99%	99%	94%	97%	100%	

100% with a mean score of 97% in the sidelying position. The mean reliability scores for the far distance ranged from 92% to 100% with a mean score of 99% in the sitting position; 75% to 100% with a mean score of 94% in the prone position; and in the sidelying position all scores were 100%.

The mean reliability scores for duration of fixations over four observations in three positions are presented in Table 2. These scores were obtained by recording the cumulative duration of fixations during the 15 second trial interval. The reliability scores for the near distance ranged from 85% to 98% with a mean score of 93% in the sitting position; 84% to 98% with a mean score of 93% in the prone position; 78% to 98% with a mean score of 92% in the sidelying position. The reliability scores for the far distance ranged from 86% to 99% with a mean score of 92% in the sitting position; 96% to 98% with a mean score of 92% in the prone position; and 85% to 99% with a mean score of 94% in the sidelying position.

Performance data on mean duration of fixations by positions are presented in Figures 1, 2, and 3. These scores are presented for the near and far distance by grid section. When in the sitting position the duration scores ranged from 6.0 seconds to 10.0 seconds for the near distance and from 2.5 seconds to 11.5 seconds for the far distance. When in the prone position the mean duration scores ranged from 3.5 seconds to 10.5 seconds for the near distance and from 4.0 seconds to 11.0 seconds for the far distance. When in the sidelying position the mean duration scores ranged from 2.5 seconds to 11.5 seconds for the near distance and from 2.5 seconds to 10.5 seconds for the far distance.

Subject 2. The mean reliability scores for frequency of fixations over four observations in two positions (sitting and sidelying) are presented in Table 3. These scores were obtained by recording the number of fixations

Table 2

Mean Reliability Scores of Four Observations for

Duration of Visual Fixation for Subject 1

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	98%	90%	84%	98%	94%	93%	93%
B	90%	92%	97%	89%	95%	85%	91%
C	96%	90%	89%	89%	82%	96%	90%
D	85%	88%	90%	97%	91%	92%	90%
E	93%	98%	96%	86%	98%	97%	95%
F	93%	98%	96%	91%	97%	99%	96%
G	98%	86%	93%	88%	92%	88%	91%
H	95%	87%	93%	90%	98%	97%	94%
I	95%	99%	92%	96%	78%	95%	92%
Total Mean Relia-bility	94%	92%	93%	92%	92%	94%	

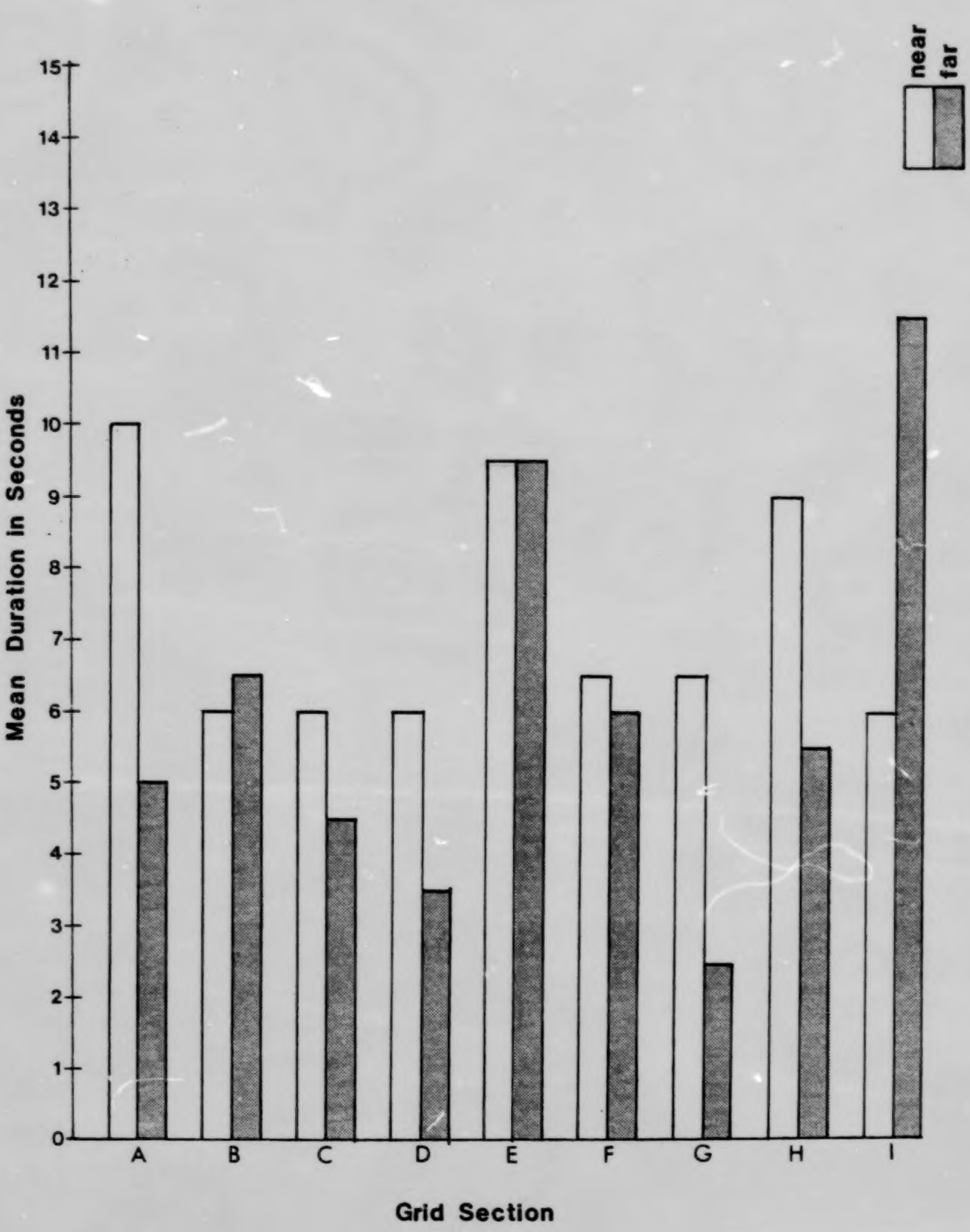

Figure 1 : Mean Duration of Visual Fixations in Sitting for Subject 1

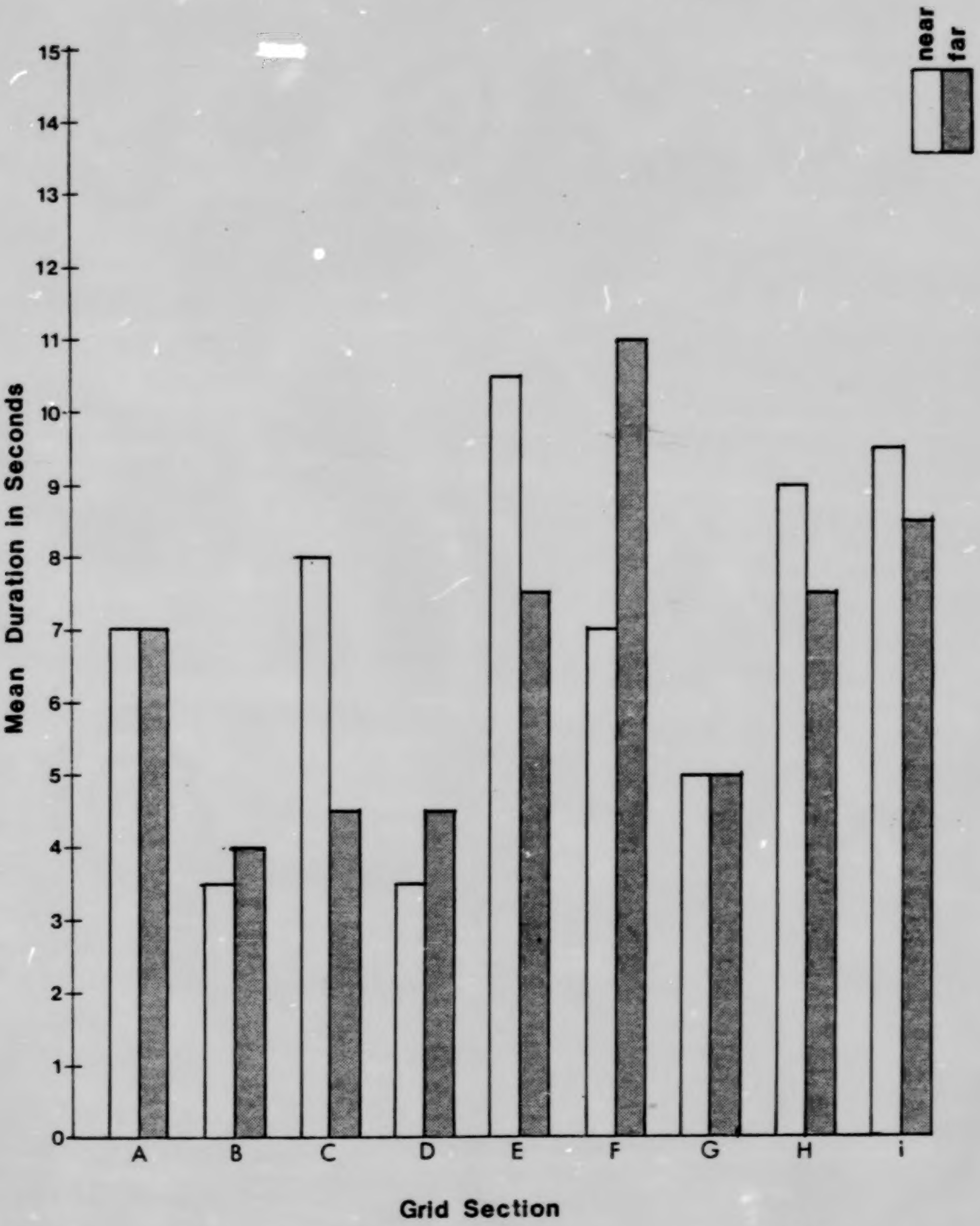

Figure 2 : Mean Duration of Visual Fixations in Prone for Subject 1

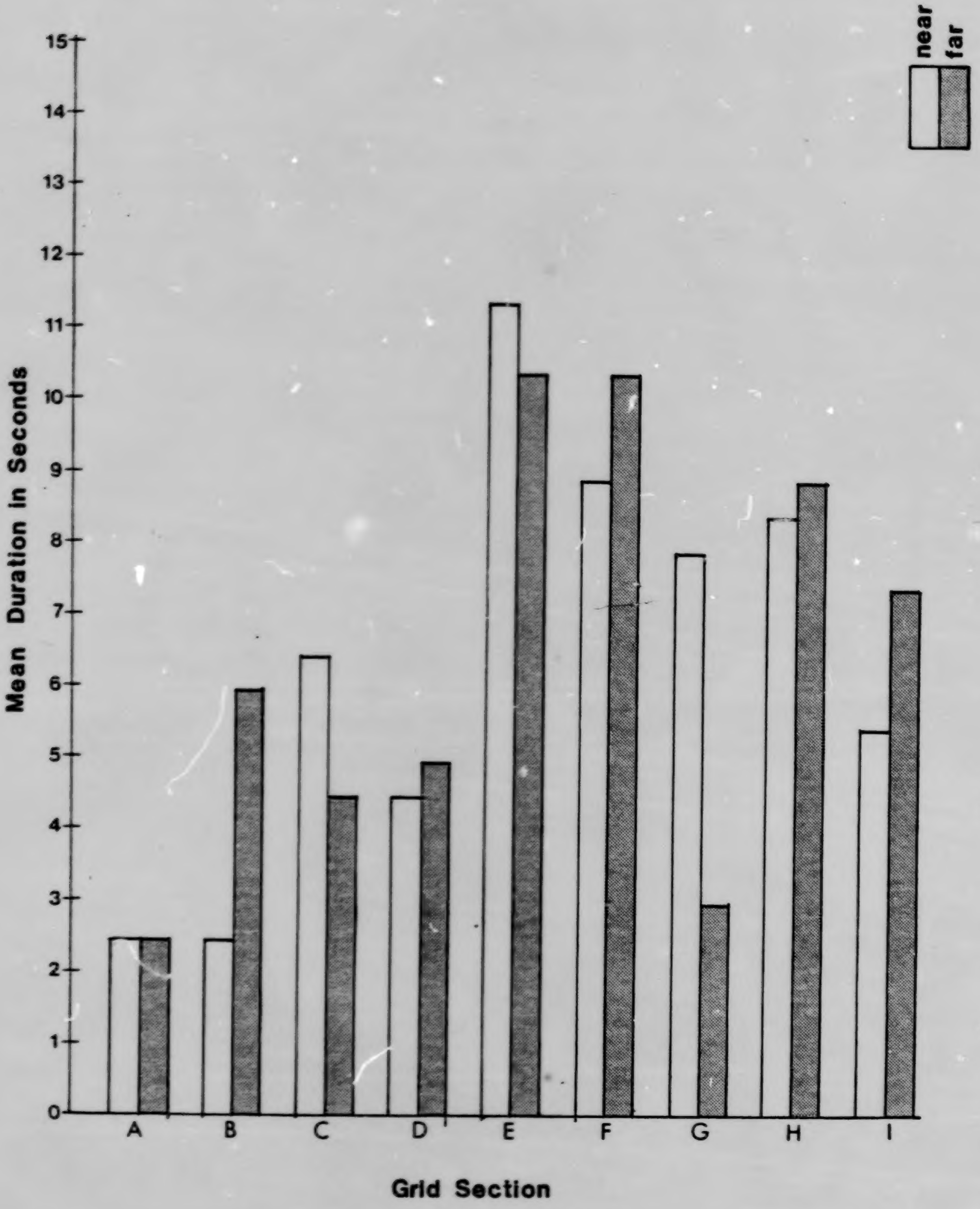

Figure 3 : Mean Duration of Visual Fixations in Sidelying for Subject 1

Table 3

Mean Reliability Scores of Four Observations for

Frequency of Visual Fixation for Subject 2

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	100%	94%			100%	100%	98%
B	92%	94%			100%	87%	93%
C	100%	100%			100%	100%	100%
D	95%	87%			100%	100%	95%
E	100%	87%			100%	100%	97%
F	100%	100%			100%	100%	100%
G	100%	94%			100%	100%	98%
H	92%	100%			100%	100%	98%
I	100%	100%			95%	87%	95%
Total Mean Reliability	98%	95%			99%	97%	

during the 15 second trial interval. The reliability scores for the near distance ranged from 92% to 100% with a mean score of 98% in the sitting position; and 95% to 100% with a mean score of 99% in the sidelying positon. The reliability scores for the far distance ranged from 87% to 100% with a mean score of 95% in the sitting position; and 87% to 100% with a mean score of 97% in the sidelying position.

The mean reliability scores of duration of fixations over four observations in two positions are presented in Table 4. These scores were obtained by recording the cumulative duration of fixations during the 15 second trial interval. The reliability scores for the near distance ranged from 80% to 99% with a mean score of 92% in the sitting position; and 88% to 99% with a mean score of 92% in the sidelying position. The reliability scores for the far distance ranged from 75% to 98% with a mean score of 90% in the sitting position; and 82% to 98% with a mean score of 92% in the sidelying position.

Performance data on mean duration of fixations by positons are presented in Figures 4 and 5. These scores are presented for the near and far distance by grid section. When in the sitting position the mean duration scores ranged from 1.5 seconds to 6.0 seconds for the near distance and from 2.0 seconds to 6.5 seconds for the far distance. When in the sidelying position the mean duration scores ranged from .5 seconds to 4.5 seconds for the near distance and from 1.0 seconds to 6.0 seconds for the far distance.

Subject 3. The mean reliability scores of frequency of fixation over four observations in two positions (sitting and prone) are presented in Table 5. These scores were obtained by recording the number of fixations during the 15 second trial interval. The reliability scores for the near distance were all 100% in the sitting position; and ranged from 87% to

Table 4

Mean Reliability Scores of Four Observations for Duration of Visual Fixation for Subject 2

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	81%	96%			96%	95%	92%
B	80%	75%			95%	82%	83%
C	88%	91%			91%	92%	90%
D	94%	79%			88%	91%	88%
E	96%	91%			91%	95%	93%
F	93%	95%			91%	90%	92%
G	99%	98%			99%	93%	97%
H	97%	97%			87%	98%	95%
I	95%	89%			90%	96%	92%
Total Mean Reliability	91%	90%			92%	92%	

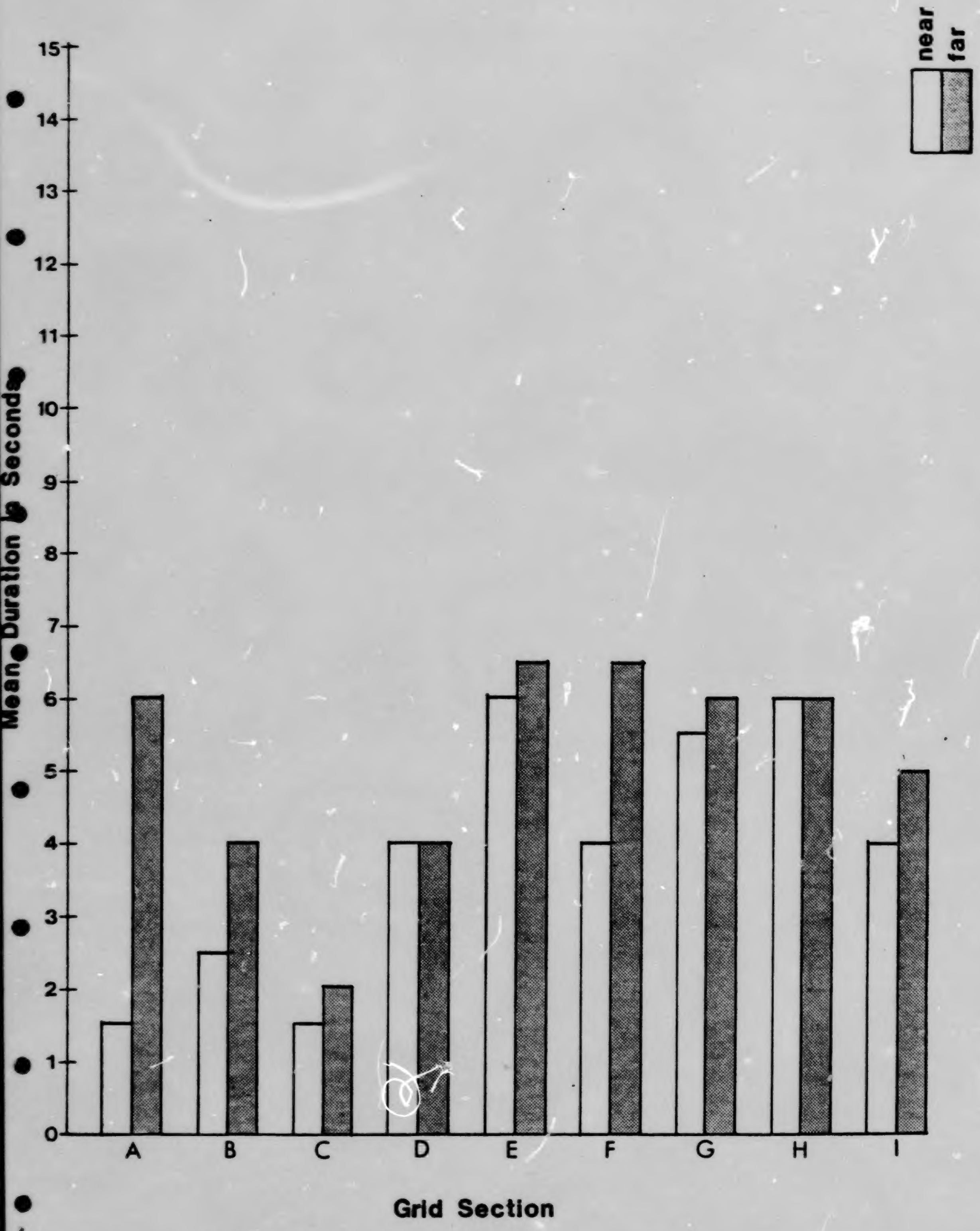

Figure 4 : Mean Duration of Visual Fixations in Sitting for Subject 2

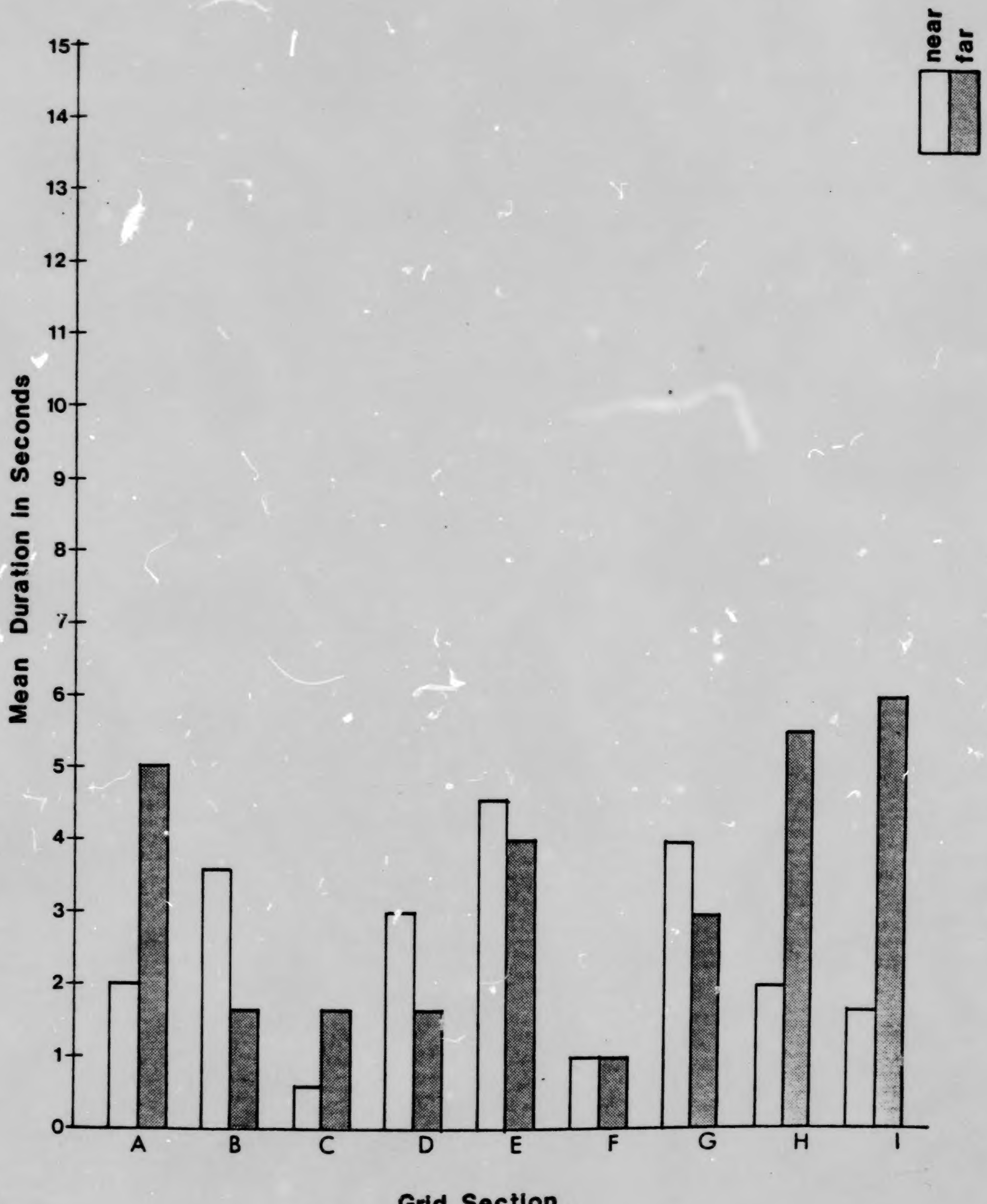

Figure 5 : Mean Duration of Visual Fixations in Sidelying for Subject 2

Table 5

Mean Reliability Scores of Four Observations for Frequency of Visual Fixation for Subject 3

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	100%	100%	100%	87%			97%
B	100%	100%	100%	100%			100%
C	100%	100%	100%	100%			100%
D	100%	100%	100%	87%			97%
E	100%	100%	100%	100%			100%
F	100%	100%	100%	87%			97%
G	100%	100%	100%	100%			100%
H	100%	100%	92%	100%			98%
I	100%	100%	87%	100%			97%
Total Mean Reliability	100%	100%	98%	96%			

100% with a mean score of 98% in the prone position. The reliability scores for the far distance were all 100% in the sitting position; and ranged from 87% to 100% with a mean score of 96% in the prone position.

The mean reliability scores of duration of fixations over four observations in two positions for Subject 3 are presented in Table 6. These scores were obtained by recording the cumulative duration of fixations during the 15 second trial interval. The reliability scores for the near distance ranged from 84% to 98% with a mean score of 94% in the sitting position; and 79% to 97% with a mean score of 91% in the prone position. The reliability scores for the far distance ranged from 76% to 98% with a mean score of 90% in the sitting position; and 75% to 96% with a mean score of 88% in the prone position.

Performance data on mean duration of fixations by positions are presented in Figures 6 and 7. These scores are presented for the near and far distance by grid section. When in the sitting position the mean duration scores ranged from 2.0 seconds to 11.5 seconds for the near distance and from 1.5 seconds to 7.5 seconds for the far distance. When in the prone position the mean duration scores ranged from 1.5 seconds to 5.5 seconds for the near distance and from 2.0 seconds to 5.5 seconds for the far distance.

Subject 4. The mean reliability scores for frequency of fixations over four observations in two positions (sitting and sidelying) are presented for the nonhandicapped infant in Table 7. These scores were obtained by recording the number of fixations during the 15 second trial interval. The reliability scores for the near distance ranged from 75% to 100% with a mean score of 94% in the sitting position; and 87% to 100% with a mean score of 97% in the sidelying position. The

Table 6

Mean Reliability Scores of Four Observations for

Duration of Visual Fixation for Subject 3

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	93%	98%	92%	94%			94%
B	95%	76%	85%	87%			86%
C	95%	88%	93%	84%			90%
D	90%	93%	94%	75%			88%
E	94%	94%	97%	93%			94%
F	98%	93%	79%	80%			87%
G	84%	95%	94%	93%			91%
H	97%	85%	87%	93%			90%
I	98%	90%	95%	96%			95%
Total Mean Reliability	94%	90%	91%	88%			

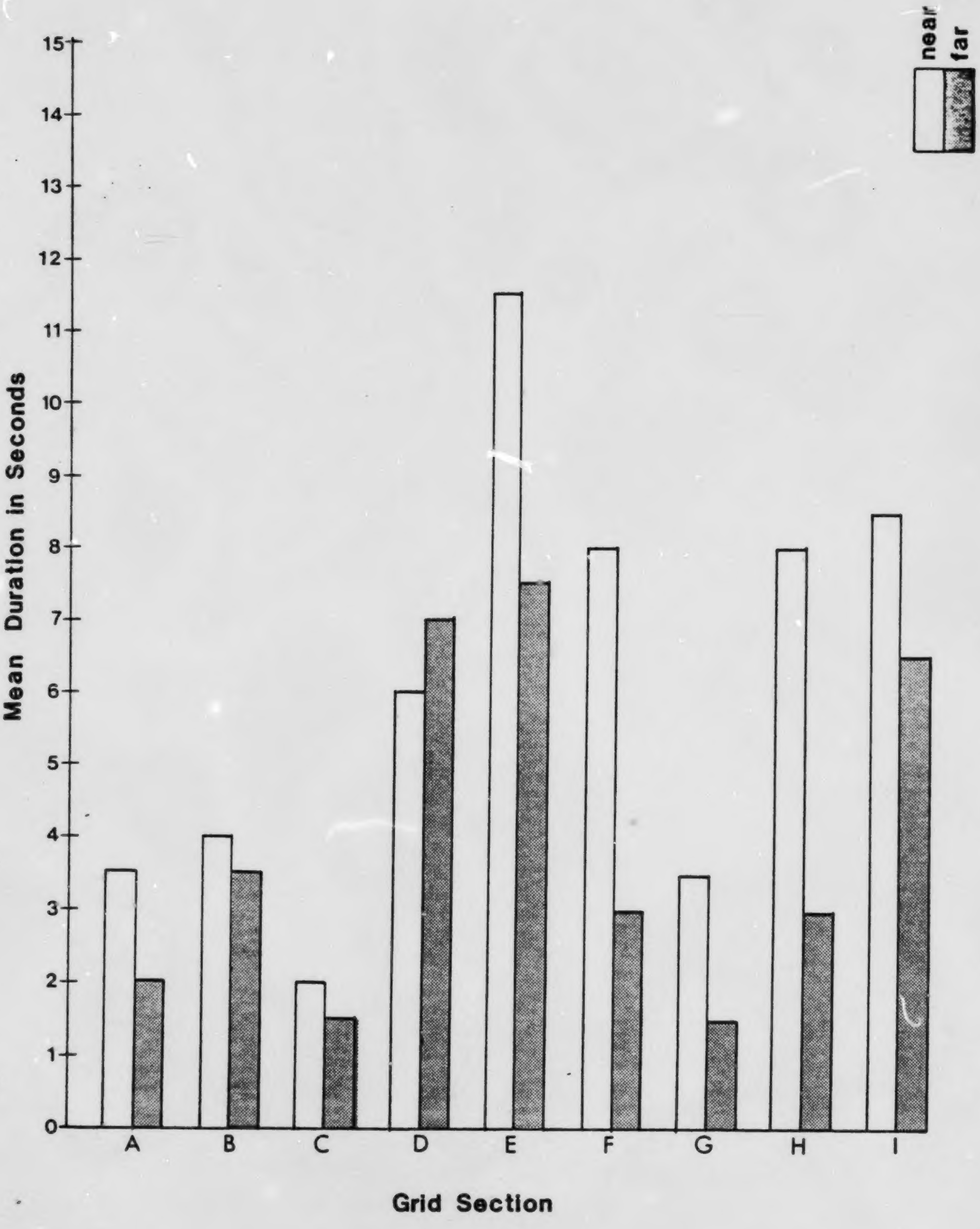

Figure 6 : Mean Duration of Visual Fixations in Sitting for Subject 3

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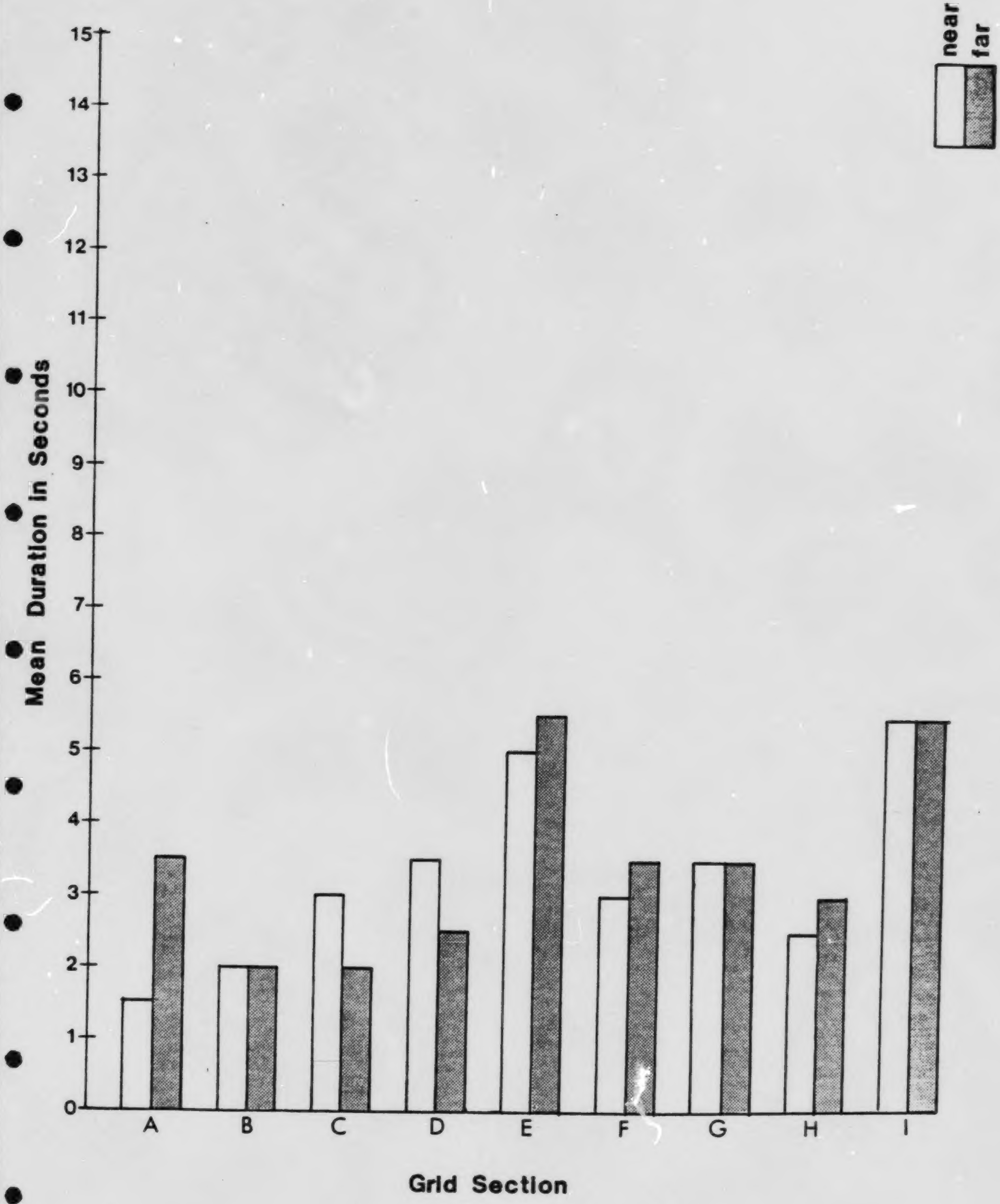

Figure 7 : Mean Duration of Visual Fixations in Prone for Subject 3

Table 7

Mean Reliability Scores of Four Observations for Frequency of Visual Fixation for Subject 4

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	100%	87%			100%	100%	97%
B	100%	100%			100%	92%	98%
C	100%	100%			100%	87%	97%
D	100%	100%			87%	100%	97%
E	75%	100%			87%	100%	90%
F	100%	87%			100%	87%	93%
G	87%	100%			100%	100%	97%
H	87%	100%			100%	100%	97%
I	100%	92%			100%	100%	98%
Total Mean Reliability	94%	96%			97%	96%	

reliability scores for the far distance ranged from 87% to 100% with a mean score of 96% in the sitting and sidelying positions.

The mean reliability scores of duration of fixations over four observations in two positions are presented in Table 8. These scores were obtained by recording the cumulative duration of fixations during the 15 second trial interval. The reliability scores for the near distance ranged from 74% to 100% with a mean score of 90% in the sitting position; and 80% to 100% with a mean score of 91% in the sidelying position. The reliability scores for the far distance ranged from 52% to 100% with a mean score of 87% in the sitting position; and 70% to 100% with a mean score of 91% in the sidelying position.

Performance data on mean duration of fixations by positions are presented in Figures 8 and 9. These scores are presented for the near and far distance by grid sections. When in the sitting position the mean duration scores ranged from 0 seconds to 5.0 seconds for the near distance and from 0 seconds to 4.0 seconds for the far distance. When in the sidelying position the mean duration scores ranged from 0 seconds to 6.0 seconds for the near distance and from 0 seconds to 4.0 seconds for the far distance.

All Subjects. Table 9 shows the combined mean reliability scores for frequency of fixations by position for all four subjects. The reliability scores for the near distance ranged from 94% to 100% with a mean score of 98% in the sitting position; 98% to 99% with a mean score of 98% in the prone position; and 97% to 99% with a mean score of 98% in the sidelying position. The reliability scores for the far distance ranged from 95% to 100% with a mean score of 97% in the sitting position; 94% to 96% with a mean score of 95% in the prone position; and 96% to 100% with a mean score of 98% in the sidelying position.

Table 8

Mean Reliability Scores of Four Observations for Duration of Visual Fixation for Subject 4

Grid Section	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
A	100%	99%			89%	92%	95%
B	74%	94%			81%	98%	87%
C	93%	88%			98%	70%	88%
D	100%	93%			90%	89%	93%
E	75%	52%			90%	90%	77%
F	82%	83%			89%	84%	84%
G	93%	89%			100%	95%	94%
H	99%	100%			100%	100%	100%
I	91%	81%			80%	93%	87%
Total Mean Reliability	90%	87%			91%	91%	

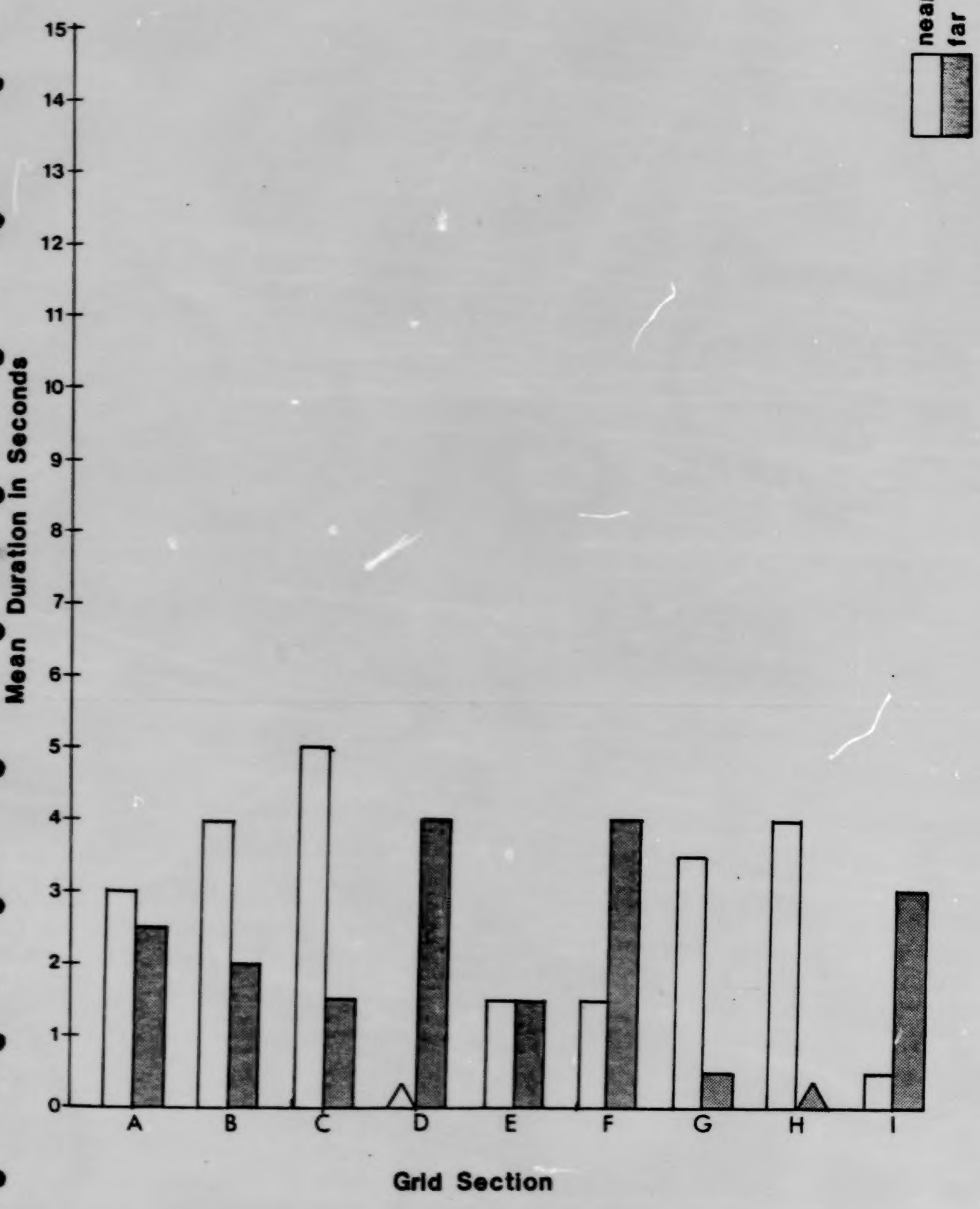

Figure 8 : Mean Duration of Visual Fixations in Sitting for Subject 4

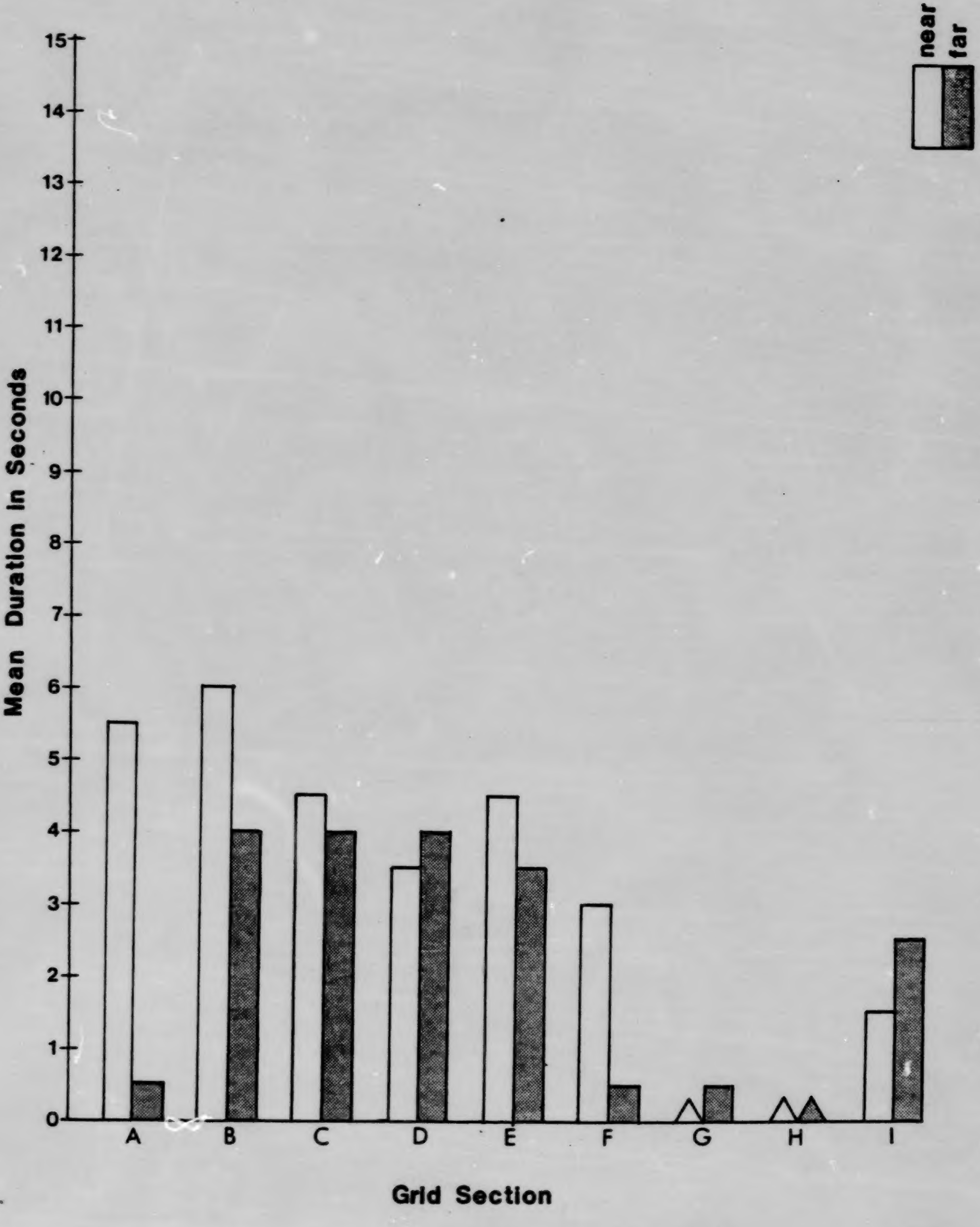

Figure 9 : Mean Duration of Visual Fixations in Sidelying for Subject 4

Table 9

Total Mean Reliability Scores for Frequency of Visual Fixations by Subject, Position, and Grid Distance

Subject	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
1	99%	99%	99%	94%	97%	100%	98%
2	98%	95%			99%	97%	97%
3	100%	100%	98%	96%			98%
4	94%	96%			97%	96%	96%
Total Mean Reliability	98%	97%	98%	95%	98%	98%	

Table 10 presents the combined mean reliability scores of frequency of fixations by grid section for all four subjects. The scores ranged from 91% to 100% with a mean score of 98%.

Table 11 shows the combined mean reliability scores for duration of fixations by position for all four subjects. The reliability scores for the near distance ranged from 90% to 94% with a mean score of 92% in the sitting position; 91% to 93% with a mean score of 92% in the prone position; and 91% to 92% with a mean score of 92% in the sidelying position. The reliability scores for the far distance ranged from 87% to 92% with a mean score of 90% in the sitting position; 88% to 92% with a mean score of 90% in the prone position; and 91% to 94% with a mean score of 92% in the sidelying position.

Table 12 presents the combined mean reliability scores for duration for fixations by grid section for all four subjects. The scores ranged from 77% to 100% with a mean score of 91%.

Discussion

The interobserver data collected on the three handicapped children and one nonhandicapped infant tested in the sitting, prone and sidelying positions indicate that this measurement procedure provides a tool that is clearly reliable for measuring frequency and duration of visual fixations.

When developing the procedures, a 30 second trial interval was used. Upon examining the data it was determined that a 15 second trial interval would be sufficient. The subjects tested, when using the 30 second trial interval, usually looked only once and it was immediately after the presentation of the cue. Furthermore, subjects' cumulative durations did not exceed 15 seconds for any one trial.

Table 10

Total Mean Reliability Scores for Frequency of Visual Fixations by Subject and Grid Section

	Grid Section									Total Mean Reliability
Subject	A	B	C	D	E	F	G	H	I	
1	100%	99%	94%	98%	98%	96%	99%	100%	100%	98%
2	98%	93%	100%	96%	97%	100%	98%	98%	96%	97%
3	97%	100%	100%	97%	100%	97%	100%	98%	97%	98%
4	97%	98%	97%	97%	91%	94%	97%	97%	98%	96%
Total Mean Reliability	98%	97%	98%	97%	96%	97%	98%	98%	98%	

Table 11

Total Mean Reliability Scores for Duration of Visual Fixations by Subject, Position, and Grid Distance

Subject	Sitting		Prone		Sidelying		Total Mean Reliability
	Near	Far	Near	Far	Near	Far	
1	93%	92%	93%	92%	92%	94%	93%
2	92%	90%			92%	92%	91%
3	94%	90%	91%	88%			91%
4	90%	87%			91%	91%	90%
Total Mean Reliability	92%	90%	92%	90%	92%	92%	

Table 12

Total Mean Reliability Scores for Duration of Visual Fixations by Subject and Grid Section

	Grid Section									Total Mean Reliability
Subject	A	B	C	D	E	F	G	H	I	
1	93%	92%	90%	91%	95%	96%	91%	94%	93%	93%
2	92%	83%	90%	88%	93%	92%	97%	95%	93%	91%
3	94%	86%	90%	88%	95%	87%	91%	90%	95%	91%
4	95%	87%	88%	93%	77%	85%	94%	100%	88%	90%
Total Mean Reliability	93%	87%	89%	90%	90%	90%	93%	95%	92%	

It was suggested in the procedures section to administer a reinforcement selection test to determine preferred items to be used as stimulus materials. It should be noted that many teachers already know which items the student prefers and this test may not be necessary.

Furtheremore, it was suggested that a total of five preferred items be selected and for each session three items be randomly presented. For most students this number may be insufficient when using these procedures. It appeared that the number and length of fixations sharply decreased as the student became familiar with the item presented. It may be useful to present unusual and novel items to attract and maintain attention.

It was not always necessary to give the stimulus item to the student as a reinforcer following each trial. Frequently, this made session length excessive as well as decreasing the subject's interest level on subsequent trials. It appeared to be more successful if the stimulus item was withheld for two or three trials.

When subjects did not fixate or were uncooperative, a short break of 5-10 minutes was usually given. If, however, during a second attempt the subject did not respond, the session was terminated for several hours or until the subject had sufficient time to rest. This necessitated conducting many sessions over a two or three day period especially with the nonhandicapped infant.

When applying the definition of visual fixation a problem was encountered relative to the stipulation of a one second duration. It was discovered that the subect could fixate for less than a second and there would be time for the examiner to record this on the stopwatch in tenths of a second. In further studies using these procedures it is suggested that the definition be rewritten or qualified to include the less than one second intervals.

Patterns in the interobserver reliability data are inconsistent concerning mean frequency and mean duration of fixation. Specific conclusions concerning performance data are difficult to determine. This is due primarily to: 1) the limited number of trials; 2) the length of time in which data were collected; and 3) the varied skill levels of subjects. The reliability scores obtained do indicate the prcedures are reliable for measuring frequency and duration of fixation. Performance data indicate that handicapped subjects performed the skill for longer durations than the nonhandicapped subjects. The present study specified that the grid be placed at a near (6"-12") and far (18"-24") distance from the student. However, based on performance data which did not indicate major differences, it is suggested that one grid distance be utilized for assessment purposes (perhaps 12"-18").

An additional suggestion is that longitudinal data be collected using these procedures. Although the procedures were found reliable with the four subjects tested, the population for which this assessment is directed is extremely variable. Therefore more subjects should be tested over extended periods of time to determine the effectiveness of these procedures for this population in general. Through longitudinal research more consistent patterns in responding may be noted. Additional data are needed which demonstrate the effectiveness of these procedures for measuring small increments of change in visual fixation over time. Furthermore, data collected over an extended period of time would be beneficial in formulating specific utilization of the procedures in a classroom setting.

In conclusion, there were no indications that data were more reliable with one particular subject, position, grid distance or grid section. Additional research should help validate this method of assessing visual fixation and provide procedures for utilization of the data obtained.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE VISUAL TRACKING AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped and Three Handicapped Children[1]

by

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and

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[1] The procedures and data reported in this study were taken from a Master's thesis by Beverly S. Humphrey that was submitted to the Department of Special Education, University of Kansas, in May, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages VO(T) 1 to VO(T) 15 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to measure the distance the eyes followed a preferred object when the child was in a sitting, prone, or sidelying position. Tracking behavior first involved fixation on a stationary object, followed by movement of the eyes which corresponded in topography to movement of the stimulus object. A 3' x 3' plexiglass grid, divided into nine sections was used to determine movement paths of stimulus objects to be tracked: horizontal left to right, horizontal right to left, vertical up to down, vertical down to up, diagonal upper left to lower right, diagonal lower right to upper left, diagonal upper right to lower left, diagonal lower left to upper right, circular clockwise, and circular counterclockwise. Tracking of objects in each of these paths was tested at two distances from the child: grid 6"-12" from child and grid 18"-24" from child.

For each trial the grid was placed directly in front of the child with the examiner directly in front of the child and grid in order to clearly view the child's eyes. A trial began when the stimulus was presented and the student was instructed to look. If fixation occurred within 5 seconds of this command the object was moved in the designated path. A trial ended when movement of the stimulus through the path was complete. The number of sections in the tracking path in which tracking occurred was recorded for each trial. Each student was tested in at least two positions with four observation sessions per position.

Subjects

The subjects selected for testing in this study consisted of three handicapped children and a nonhandicapped infant. The handicapped subjects attended a public school and were chosen from two severely multiply handicapped classrooms. Selection requirements were primarily based on prolonged visual attention to preferred items on a regular basis. All subjects were ambulatory, although it was not a criterion for selection.

Subject 1. NH was a 7½ year old female with mild cerebral palsy. She scored at the 2 year age level on the Beery-Buktenica Test of Visual-Motor Integration and had fucntional use of vision.

Subject 2. DM was a 9½ year old male with no apparent sensory impairment. According to the Bayley Scale of Infant Development, he demonstrated a mental age of 12 months.

Subject 3. GR was a 10 year old male with functional use of vision but an estimated moderate to severe sensorineural hearing impairment. According to the Stanford Binet (Form L-M), his estimated mental age was below 2 years of age.

Subject 4. SG was a normally developing male infant who was observed from four to eight weeks of age.

Procedures for Obtaining Measures of Reliability

Reliability measures were recorded and computed for each trial of every session. A second examiner (observer) was positioned in close enough proximity to have a full view of the subject's eye movements. Both examiners faced the student who was positioned on the other side of the grid. Instructions consisted of explaining the data sheet in detail along with pointing out the section labels to accurately identify sections which the student tracked with a plus (+), and sections not tracked with a minus (-). Also, as each stimulus was presented it was checked off in the appropriate column for each trial. The entire session was completed before a comparison was made of the tracking responses observed by each person who scored.

The degree of reliability was determined by using the following formula:

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements} + \text{number of disagreements}}$$

For each trial, the total number of agreements was established by comparing the data for each examiner under the sections tracked columns. The number of agreements was added to the number of disagreements to represent the total number possible. The percent of reliability was derived by dividing the number of agreements by the number of agreements plus the number of disagreements.

Results

In this section reliability scores are presented for the four subjects by positions in which visual tracking behavior was measured. The scores reflect data taken on each tracking pathway in the positions of sitting, sidelying, and prone for both near and far locations of the grid. Performance data of per cent sections tracked are presented by subject.

Reliability Data

Sitting. The total mean reliability score for all of the conditions in the sitting position was 96%. Table 1 itemizes these scores by pathway and grid location for each subject. The scores ranged from 75% to 100% when the grid was placed at the near distance with a mean score of 96%. At the far distance, the scores ranged from 82% to 100% with an average score of 96%. The 10 tracking pathways were divided into their respective planes, the scores were then averaged to determine

Table 1

Mean Reliability of Four Observations of Visual Tracking by Subject, Grid Placement, and Tracking Pathway when in the Sitting Position

Paths	Subject 1		Subject 2		Subject 3		Subject 4		Total Mean Reliability	
	near	far	near	far	near	far	near	far	by path	by plane
→	100%	92%	92%	92%	92%	100%	100%	92%	96%	97% horizontal
←	100%	100%	100%	92%	100%	100%	100%	92%	98%	
↗	100%	100%	100%	100%	100%	100%	100%	100%	100%	98% diagonal
↙	100%	100%	100%	83%	83%	100%	100%	100%	96%	
↖	92%	100%	92%	92%	100%	100%	100%	100%	97%	
↘	100%	100%	83%	100%	100%	100%	100%	100%	98%	
↑	100%	100%	100%	100%	83%	100%	100%	100%	98%	97% vertical
↓	100%	100%	100%	83%	100%	92%	92%	100%	96%	
↻	75%	94%	97%	88%	85%	88%	97%	97%	90%	91% circular
↺	94%	97%	94%	82%	88%	91%	88%	91%	91%	
Total Mean Reliability	96%	98%	96%	91%	93%	97%	98%	97%	96%	
Total Mean Reliability near and far	97%		94%		95%		98%			

the degree of reliability for each plane. The greatest degree of mean reliability was 98%, found in the four diagonal pathways. These figures ranged from 83% to 100%. The horizontal and vertical planes each averaged 97% for their two respective pathways. The paths in the vertical plane had scores which ranged from 83% to 100%. Reliability for the horizontal pathways ranged from 92% to 100%. The circular paths had the greatest variation of agreement, from 75% to 97%, with an average of 91%. The mean reliability scores for each of the four subjects are also given in Table 1. The reliability scores for Subject 1 ranged from 75% to 100%, with a mean of 97%. Scores for Subject 2 ranged from 82% to 100% with a mean of 94%. Scores for Subject 3 ranged from 83% to 100% with a mean of 95%. The highest degree of reliability was seen in Subject 4 with a mean of 98% and a range from 88% to 100%.

Sidelying. The total mean reliability score was 94% for all of the conditions in the sidelying position. These scores are listed by pathway and grid positons for each student in Table 2. The scores ranged from 75% to 100% for both the near and far positions of the grid with a mean of 94%. The extent of reliability for each tracking plane was determined by sorting the 10 pathways into the appropriate plane and averaging the scores for each plane. The two horizontal paths revealed the highest degree of agreement in the sidelying position with a mean of 98%, ranging from 83% to 100%. Scores in the diagonal plane averaged 96% with the four respective pathway scores ranging from 75% to 100%. Vertical plane scores also ranged from 75% to 100% with a mean score of 90%. Reliability scores in the circular pathways ranged from 79% to 100% with a mean of 89%. Table 2 also indicates mean reliability scores for each of the four subjects. Inter-observer reliability for Subjects 1, 3 and 4 ranged from 75% to 100% with a mean

Table 2

Mean Reliability of Four Observations of Visual Tracking by Subject, Grid Placement, and Tracking Pathway when in the Sidelying Position

	Subject 1		Subject 2		Subject 3		Subject 4		Total Mean Reliability	
Paths	near	far	near	far	near	far	near	far	by path	by plane
→	100%	100%	100%	100%	92%	100%	100%	92%	98%	98% horizontal
←	100%	83%	100%	100%	92%	100%	100%	100%	97%	
↗	100%	100%	100%	100%	100%	92%	100%	100%	99%	96% diagonal
↙	75%	83%	100%	92%	100%	100%	92%	92%	92%	
↖	100%	100%	92%	92%	100%	100%	100%	83%	96%	
↘	92%	92%	100%	100%	100%	100%	83%	100%	96%	
↑	83%	100%	83%	92%	75%	92%	83%	100%	86%	90% vertical
↓	100%	83%	100%	100%	92%	100%	100%	75%	94%	
↻	82%	83%	100%	82%	79%	85%	82%	91%	85%	89% circular
↺	91%	85%	100%	85%	91%	97%	91%	100%	93%	
Total Mean Reliability	92%	91%	98%	94%	92%	97%	93%	93%	94%	
Total Mean Reliability near and far	92%		96%		95%		93%			

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of 92% for Subject 1, 95% for Subject 3, and 93% for Subject 4. Scores for subject 2 ranged from 82% to 100% with a mean of 96%.

Prone. The total mean reliability score for all of the conditions in the prone positon was 96%. These scores are specified by pathway and grid location for each subject in Table 3. When the grid was placed at the near distance, the scores ranged from 85% to 100% with a mean score of 96%. When placed at the far distance, the scores ranged between 83% and 100% with a mean score of 97%. The various tracking pathways were separated into their respective tracking planes to determine the degree of reliability in each plane. The mean scores in the vertical palne ranged from 92% to 100% with a grand mean of 98%. The paths in the diagonal plane averaged 97% and ranged from 83% to 100%. Total reliability in the two horizontal pathways averaged 96% and ranged from 92% to 100%. The overall mean reliability score in the circular plane was 94% with the scores ranging from 85% to 100%. Scores for Subject 1 ranged from 91% to 100% with a total mean score of 96%. The range of reliability for Subject 2 was from 83% to 100% with the mean reliability at 97%.

Performance Data

Subject 1. Performance data of percent of section tracked for this subject are presented in Figures 1, 2, and 3. The mean percent of pathways tracked in the sitting positon was 98% with both near and far locations of the grid. Mean scores in the sidelying position for the near and far distances were 92% and 89% respectively with a total mean score of 91%. In the prone position, the total mean score was 92% with mean scores at the near distance of 89% correct and 93% correct at the far distance. Performance in the horizontal and diagonal planes averaged 94% and 95% respectively. The lowest performance score of 91% was in the circular plane.

Table 3

Mean Reliability of Four Observations of Visual Tracking by Subject, Grid Placement, and Tracking Pathway when in the Prone Position

	Subject 1		Subject 2		Total Mean Reliability	
Paths	near	far	near	far	by path	by plane
→	92%	92%	92%	100%	94%	96% horizonta
←	100%	100%	100%	92%	98%	
↗	92%	100%	100%	100%	98%	97% diagonal
↙	92%	92%	100%	100%	96%	
↖	100%	92%	100%	83%	96%	
↘	100%	92%	100%	100%	98%	
↑	92%	100%	92%	100%	96%	98% vertical
↓	100%	100%	100%	100%	100%	
↻	94%	91%	85%	97%	92%	94% circular
↺	91%	100%	94%	97%	96%	
Total Mean Reliability	95%	97%	96%	97%	96%	
Total Mean Reliability near and far	96%		97%			

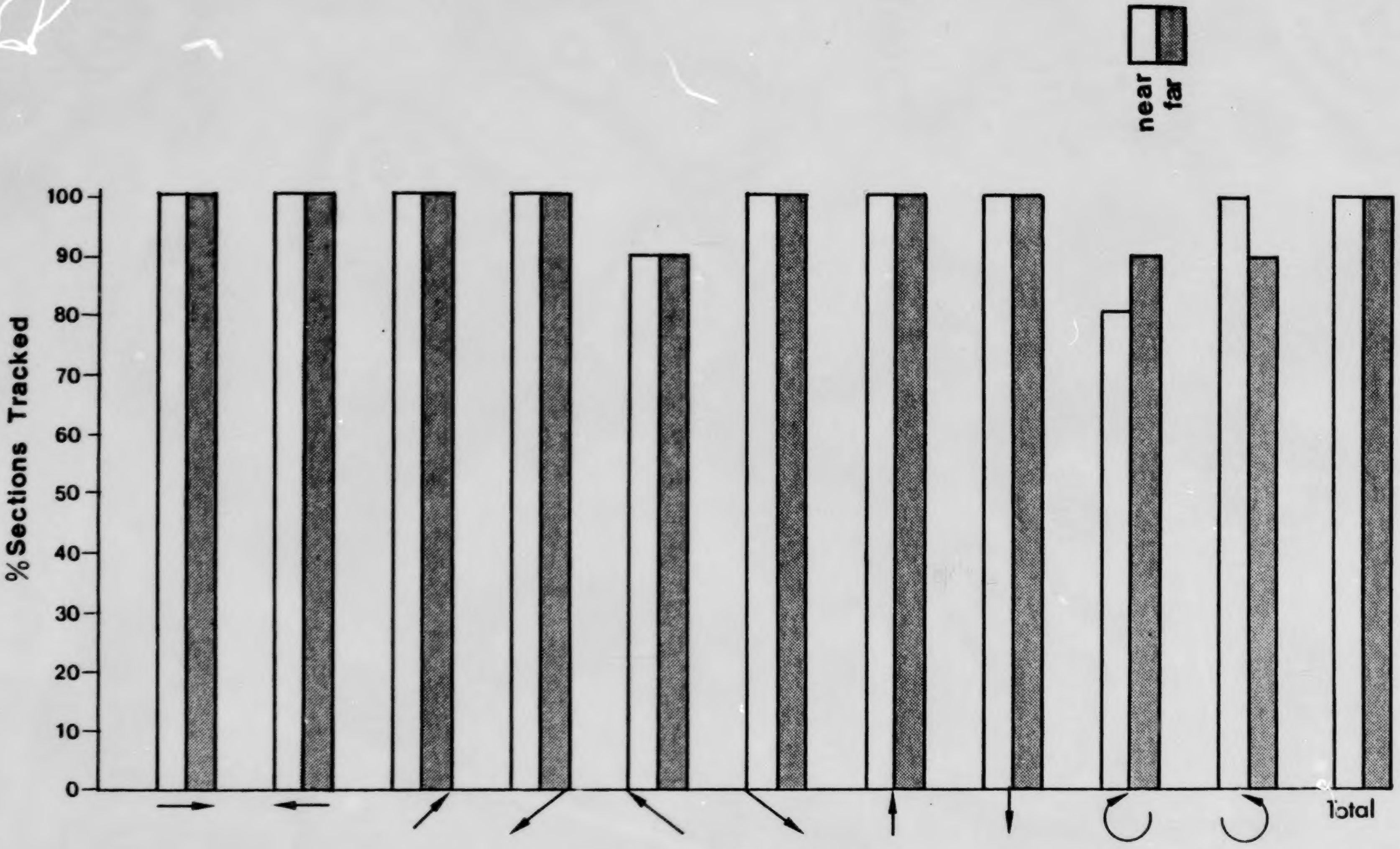

Figure 1 :Mean Performance by Tracking Pathway in Sitting for Subject 1

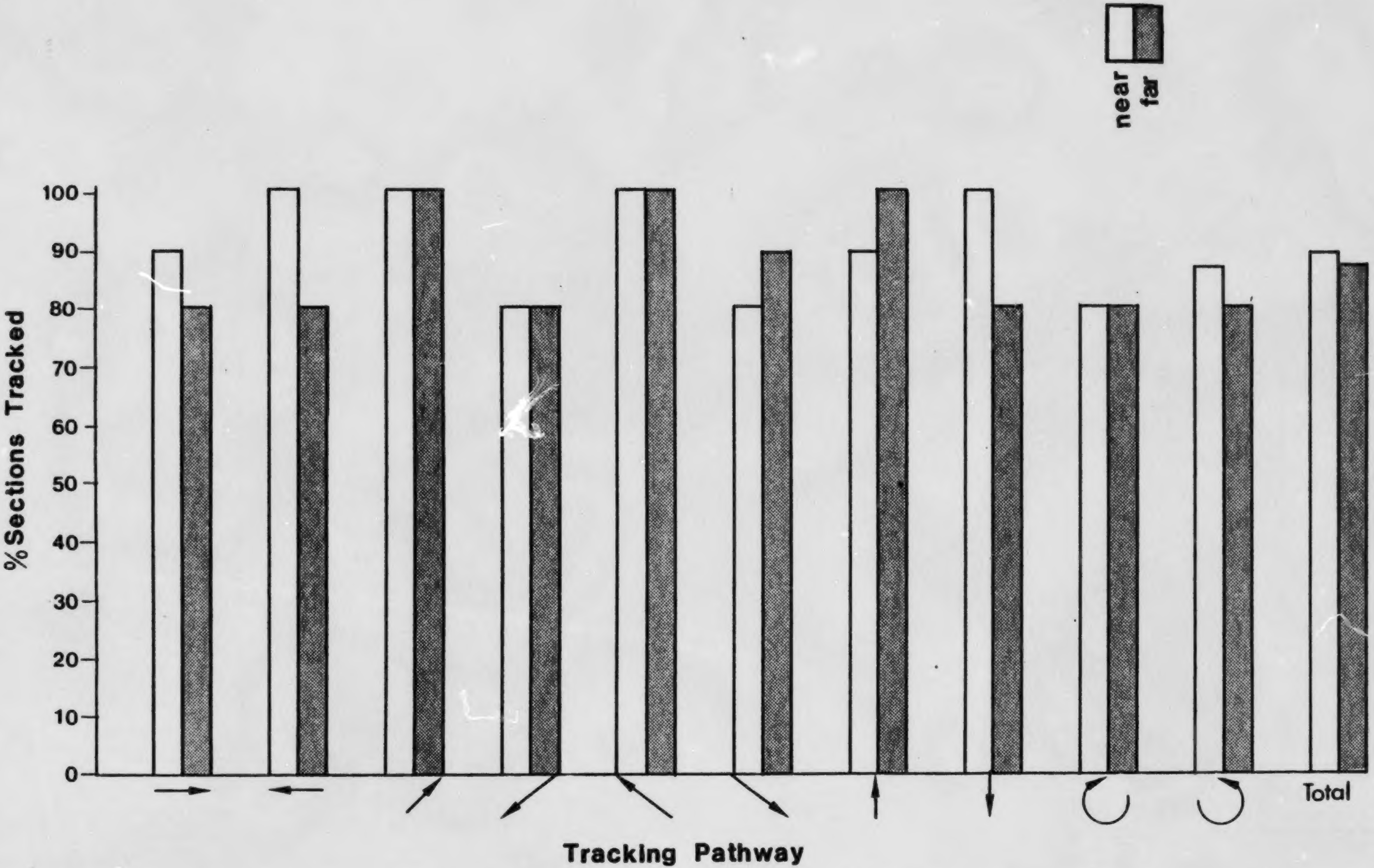

Figure 2 :Mean Performance by Tracking Pathway in Sidelying for Subject 1

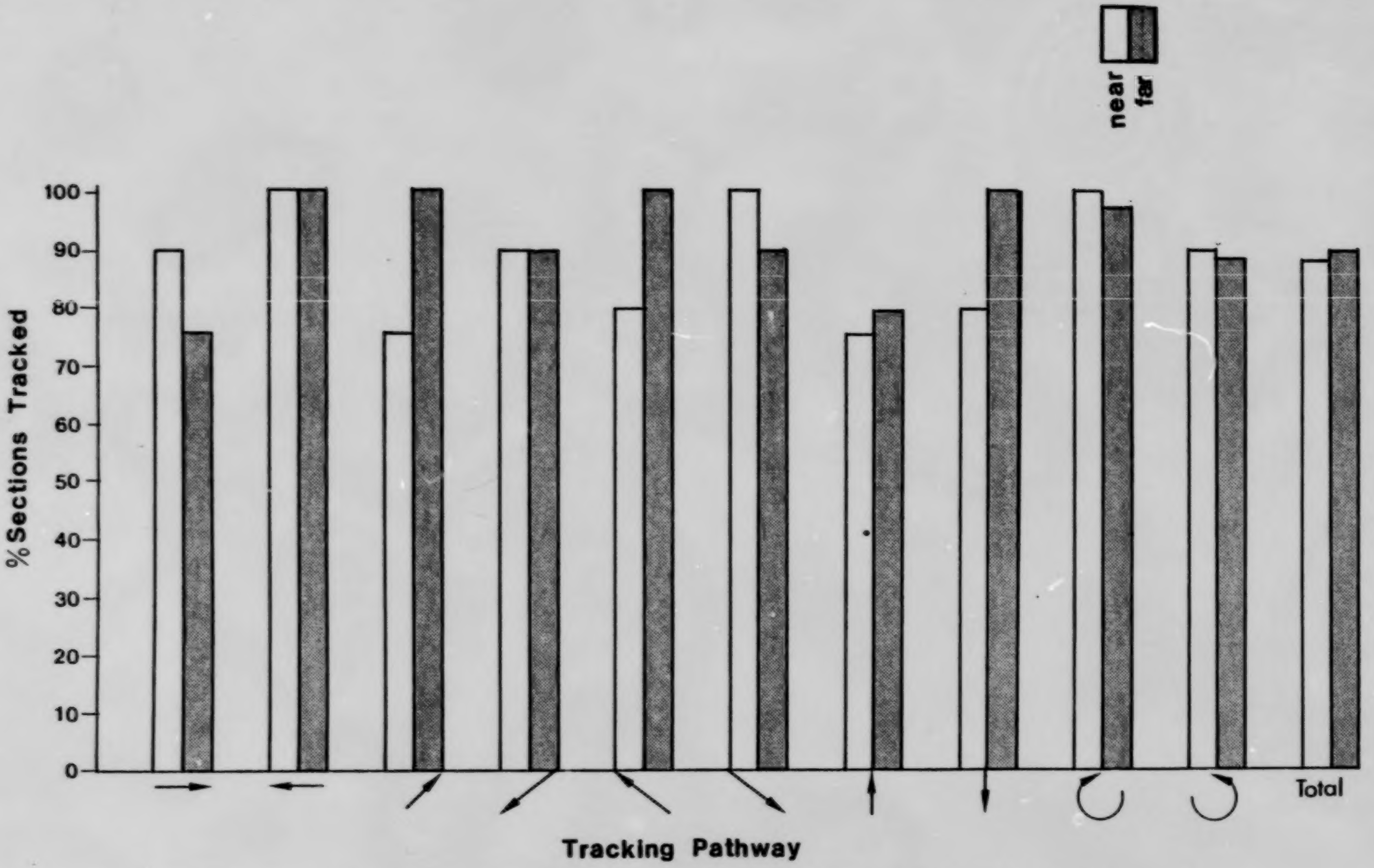

Figure 3 :Mean Performance by Tracking Pathway in Prone for Subject 1

Subject 2. Figures 4, 5, and 6 present mean performance data for Subject 2 in each position using both grid locations. Scores in the sitting position averaged 93% for both locations of the grid. In sidelying, the mean percent of tracking responses was 93%; a mean score of 95% with the grid at the near location and 90% at the far location. The mean percent of sections tracked in the prone position was 86%. Tracking in the near position averaged 82% correct and 90% in the far position. Overall, the lowest tracking scores occurred in pathways of the horizontal plane as reflected with the mean score of 85%. The two pathways of the vertical plane received the best responses from the subject where the average score was 95% correct.

Subject 3. Mean performance data for position and grid locations are presented in Figures 7 and 8. Only two positions were tested with this subject. The mean performance score in the sidelying position was 87%. The total mean percent tracked in the sidelying position equaled 81% at the near grid location and 92% at the far location. While sitting, the subject's mean score was 85% correct with an average of 80% and 86% for the near and far distances respectively. Across both positions of the subject, sections in the vertical plane were tracked more frequently, as seen with the mean score of 92%. The ciruclar pathways received the least percent of sections tracked with a score of 78%.

Subject 4. Performance data for this subject (nonhandicapped infant), are represented in Figures 9 and 10. The mean sidelying score was 27% sections tracked. Tracking averaged 30% at the far distance, and 24% at the near distance. In the sitting position, the mean performance score was 24%; both near and far positions of the grid averaged the same. The horizontal and vertical planes were tracked with mean scores of 28% and 29% respectively.

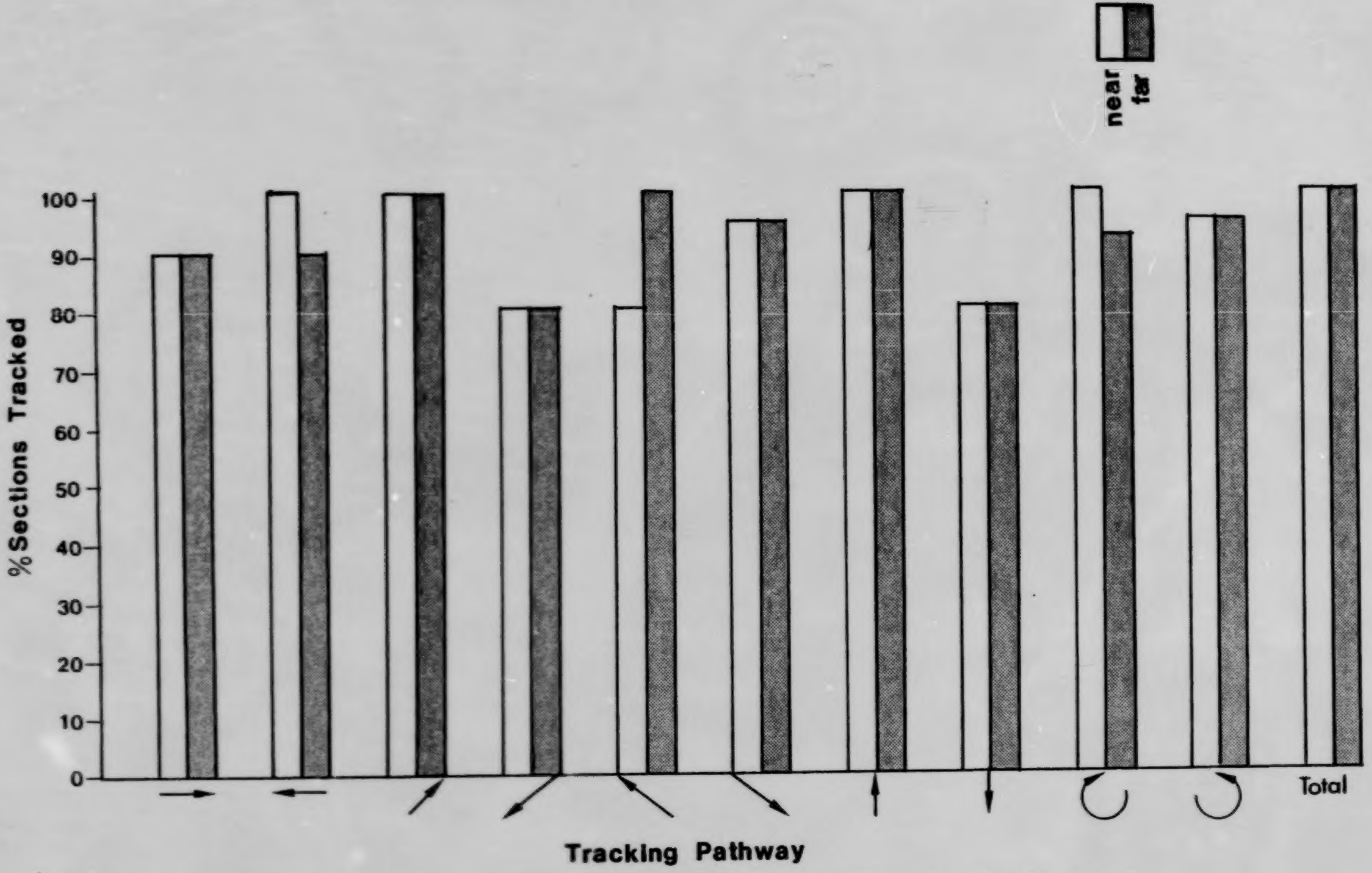

Figure 4 :Mean Performance by Tracking Pathway in Sitting for Subject 2

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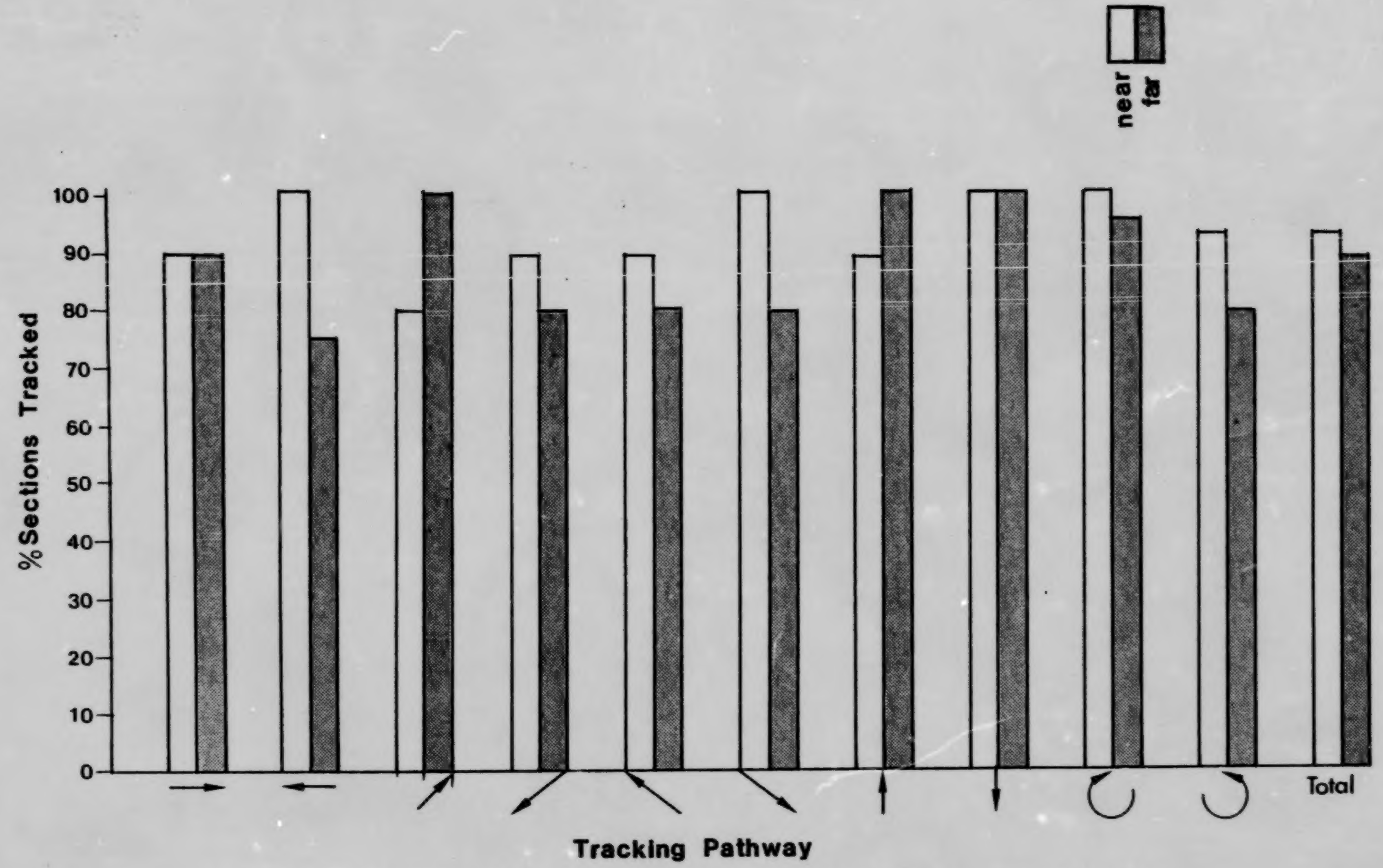

Figure 5 :Mean Performance by Tracking Pathway in Sidelying for Subject 2

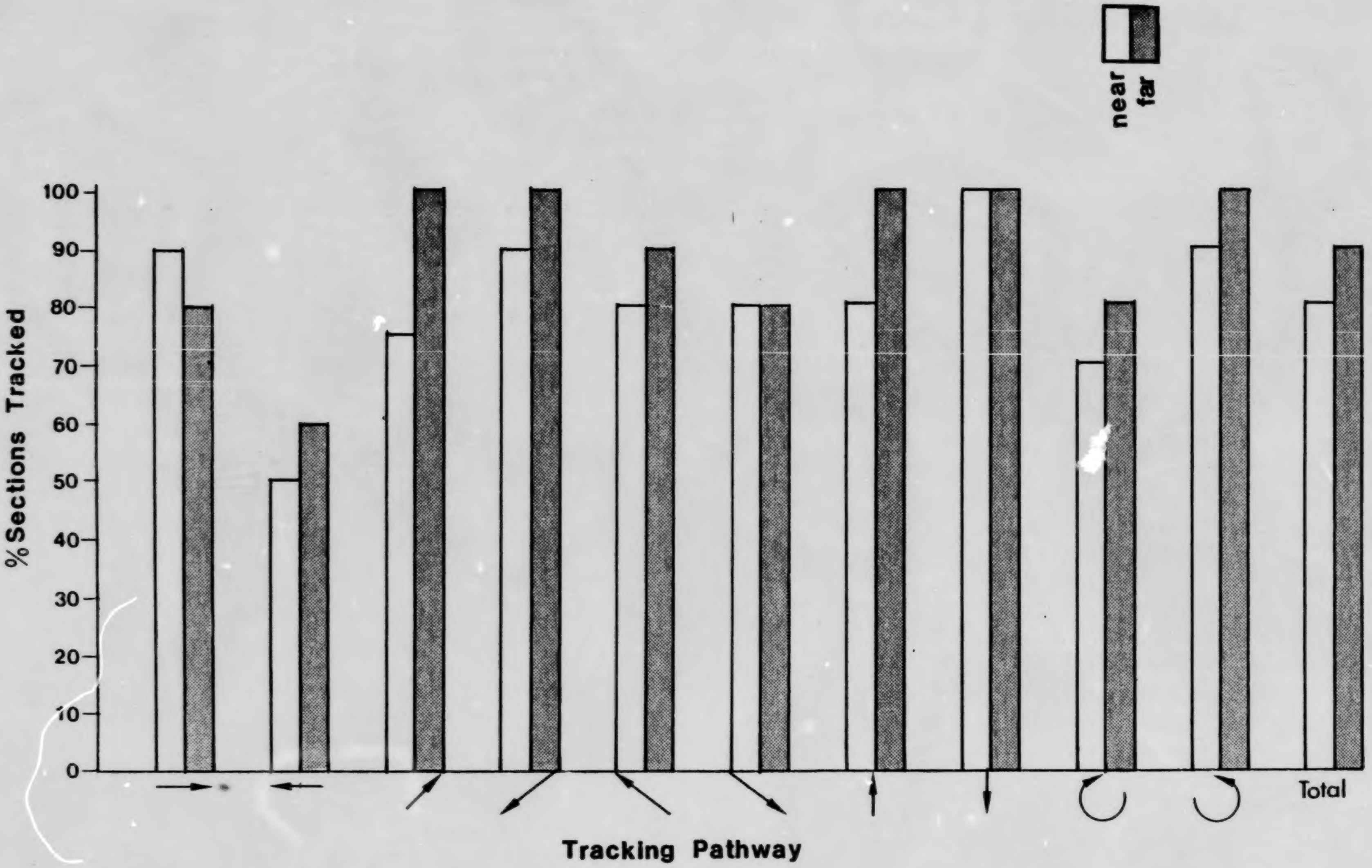

Figure 6 :Mean Performance by Tracking Pathway in Prone for Subject 2

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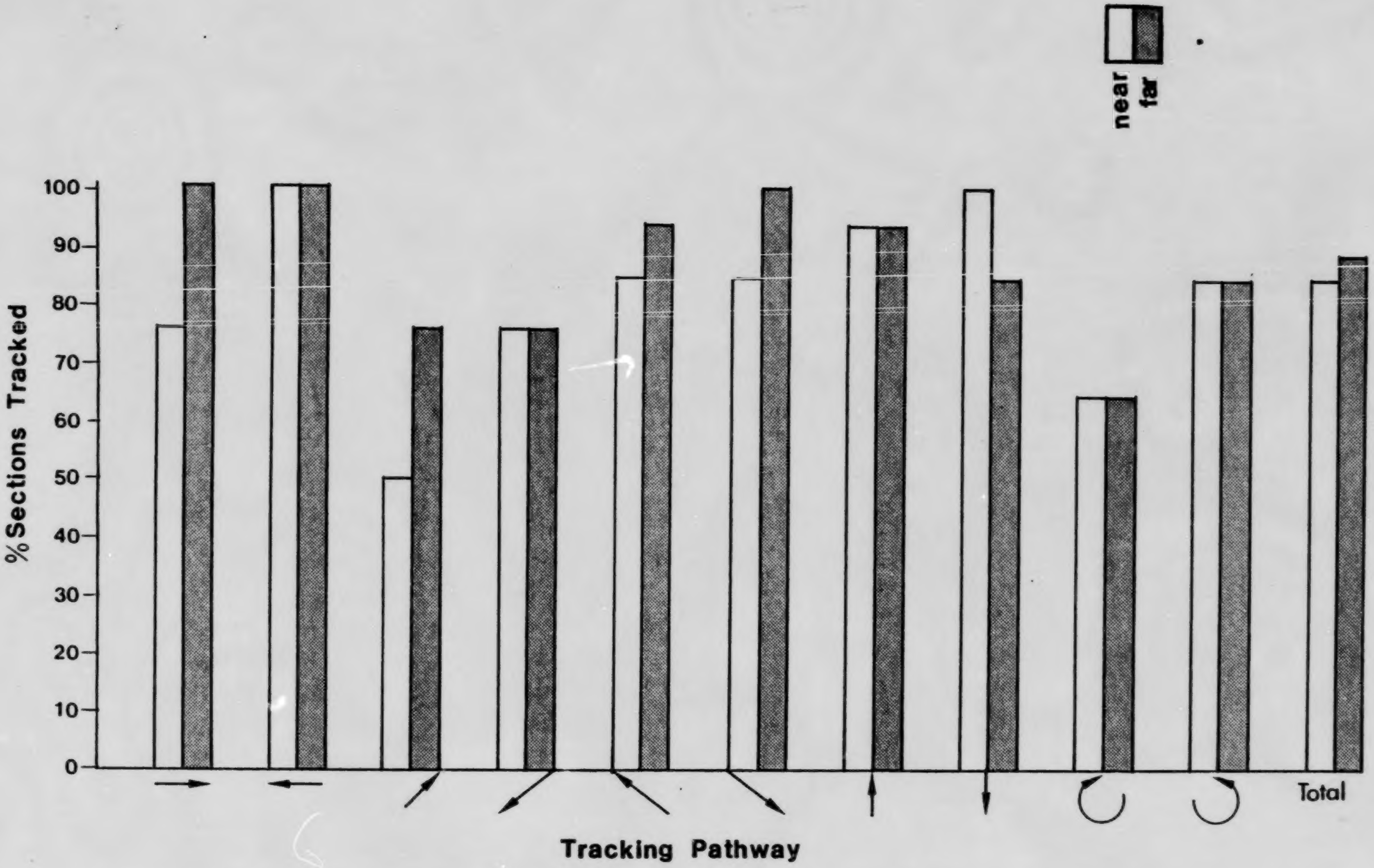

Figure 7 :Mean Performance by Tracking Pathway in Sitting for Subject 3

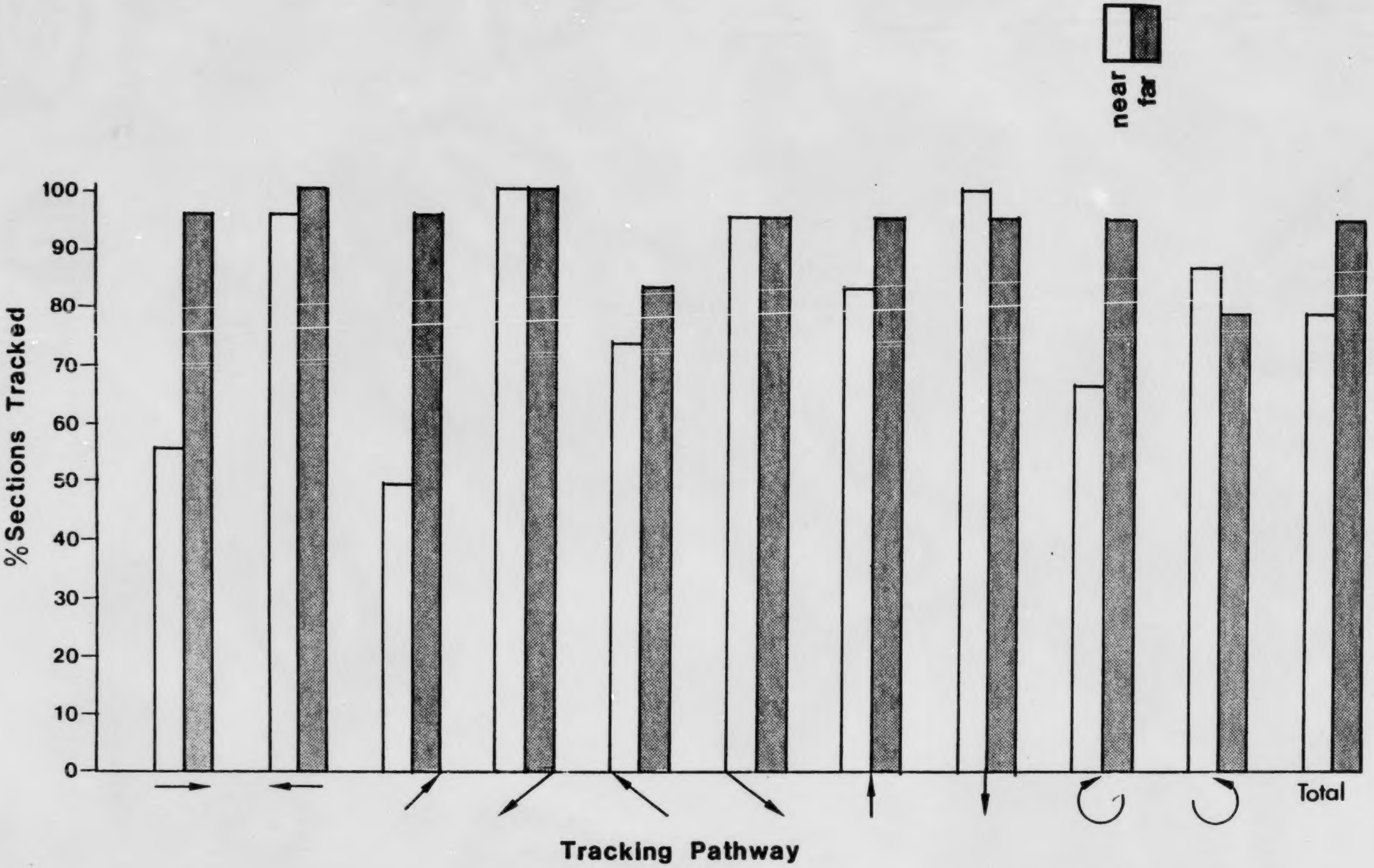

Figure 8 :Mean Performance by Tracking Pathway in Sidelying for Subject 3

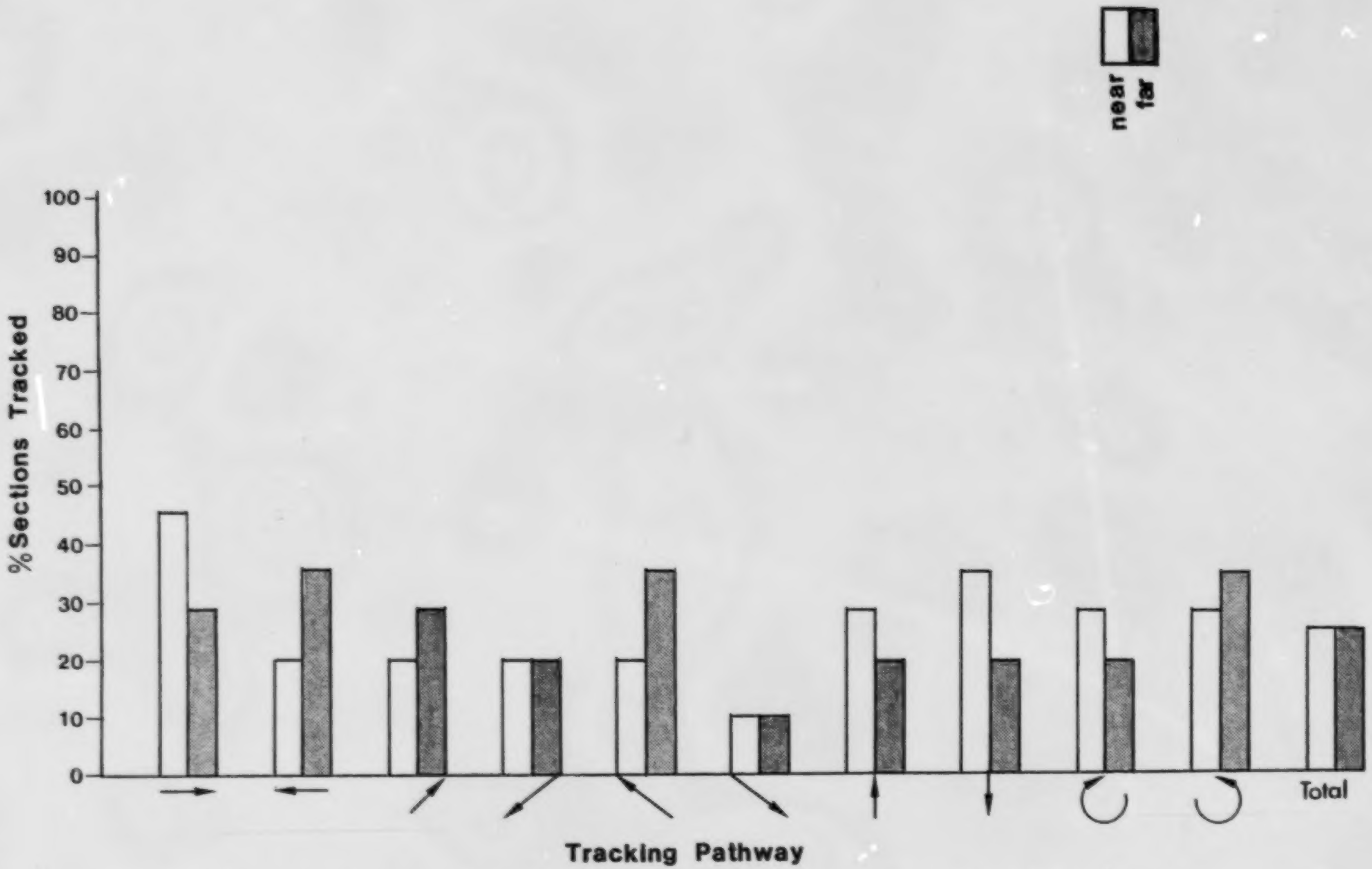

Figure 9 :Mean Performance by Tracking Pathway in Sitting for Subject 4

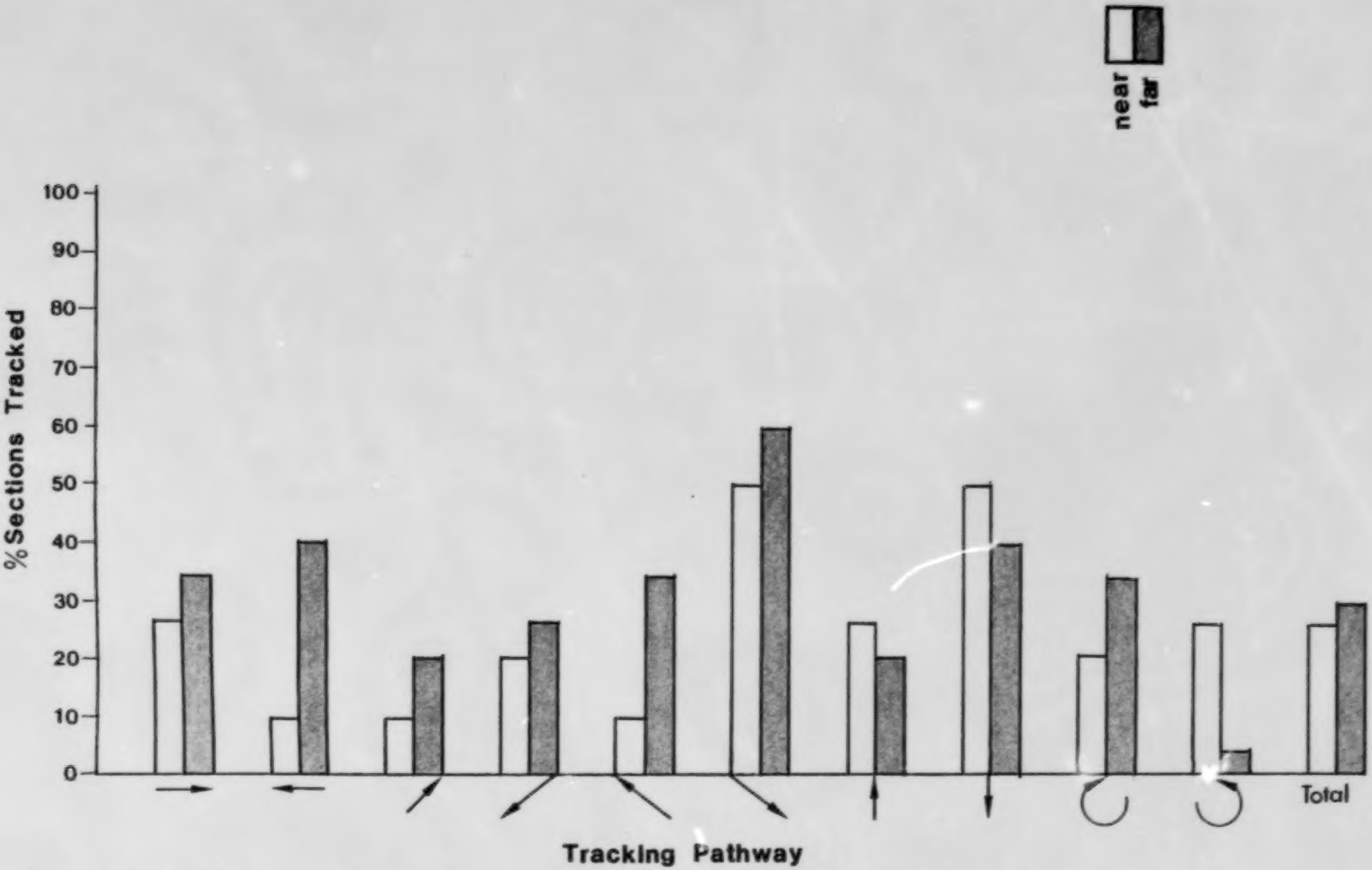

Figure 10 :Mean Performance by Tracking Pathway in Sidelying for Subject 4

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The diagonal and circular planes received mean performance scores of 23% each.

All subjects. Table 4 compares total mean reliability scores by position, subject, and grid placement and Table 5 displays mean reliability scores for each tracking plane across each position. The overall mean reliability score across all conditions was 95%.

Discussion

The inter-observer reliability results indicate that the procedures used to assess visual tracking are reliable across three handicapped children and one nonhandicapped infant, regardless of position of the child, placement of the grid, or specific tracking pathway.

This method of assessing visual tracking skills is flexible enough to accommodate students with limited physical capacities and yet clearly states specific conditions required for testing. The positions for placement of the subject have been expanded from traditional measures to include sidelying and prone, in addition to sitting. The specific posture of each position depends on what is most comfortable to the child, thus allowing for various physical limitations of the subject. Traditional asssessment information primarily indicates the occurrence or non-occurrence of tracking skills. These procedures measure tracking ability in specific tracking pathways which have been classified into tracking planes and defined in observable terms. Placement of the testing apparatus and stimuli is also stated. The stimuli should be presented approximately 6 to 12 inches in front of the subject when the grid is placed at the near distance and about 18 to 24 inches away from the subject when the grid is positioned at the far distance. The stimulus items used to elicit tracking reponses are not standard as in many other assessments. Instead, they are determined by whether they are preferred by the student, thus allowing for individual

Table 4

Total Mean Reliability of Visual Tracking by Position, Subject and Grid Placement

Subjects	Sitting		Sidelying		Prone		Total Mean Reliability
	near	far	near	far	near	far	
1	96%	98%	92%	91%	95%	97%	95%
2	96%	91%	98%	94%	96%	97%	95%
3	93%	97%	92%	97%			95%
4	98%	97%	93%	93%			95%
Total Mean Reliability	96%	96%	94%	94%	96%	97%	95%

Table 5

Total Mean Reliability of Visual Tracking by Tracking Plane and Subject Position

Position	Plane				Total Mean Reliability
	horizontal	diagonal	vertical	circular	
Sitting	97%	98%	97%	91%	96%
Sidelying	98%	96%	90%	89%	93%
Prone	96%	97%	98%	94%	96%
Total Mean Reliability	97%	97%	95%	91%	95%

differences and increasing the likelihood of attending throughout the entire session.

Practical application of these procedures may help provide direction for further specialized testing as well as programming needs and teaching strategies. Such information would be especially useful to the classroom teacher. The comment section on the data sheet provides space for each trial in which to note specific observations such as eye jerks when crossing midline, tracking with one eye only, easily distracted, etc. By consistently noting such observations it may be easier to become aware of subtle problems which might otherwise go unnoticed. For example, difficulty crossing midline with a smooth movement may indicate perceptual problems; pursuit movements with only one eye may imply that only single eye control has been established, and perhaps training should include monocular as well as binocular activities (Kephart, 1971). A subject who is consistently distracted with minor events may need more specific attending skills rather than an emphasis on visual tracking. In any case, if specific patterns or concerns prevail, it may be a good indication that more specific opthamological testing is necessary.

If one or more planes appear to be significantly deficient, perhaps specific training programs could be initiated for remediation. The teacher may also want to examine plane preferences and consider placing training materials in corresponding patterns in front of the child. If the circular plane is preferred, the subject may respond to stimulus items placed in a circular pattern, more readily than the typical placement of objects in a horizontal plane. If effective, this procedure could have valuable implications throughout any number of program areas, i.e., communication boards, pre-academic, and pre-vocational, etc.

Not only does this assessment method merit attention as a clear and simple measurement device for visual tracking skills, it has further possibilities for testing as well. By slightly altering the measuring apparatus, the procedures may be adapted for testing visual skills such as visual fixation and visual scannning.

Although the method presented in this study provides reliable objective measures for testing, future studies may want to consider how it could be made more functional or determine how it logistically fits into a total assessment package.

Longitudinal research would provide further validity to this assessment procedure and could be particularly valuable with larger subject samples in determining performance patterns and detecting small increments of change. With further study, perhaps concrete information could be avaiable on the interpretation of data obtained with these measures and the respective implications they may have for training visual tracking skills.

Further study utilizing certain procedural changes would also be helpful. When it was necessary to represent the stimulus object to obtain a fixation response, the student usually only needed two additional presentations rather than four. If the subject fixated at all for a specific trial it usually occurred by the third presentation. By omitting only two opportunities for fixation it would decrease the length of the session.

The present study made allowances for the grid to be placed in front of the subject at both a near distance and a far distance. Results indicated there were not enough differences among students' performance which would warrant testing in both locations. Further, investigation could determine if different distances would be more suitable, if there is even a need for both positions, or if one medium location, between the others, may be more appropriate for assessment purposes.

The final procedural component to be considered for improvement concerns the length of each session. In this procedure, the session time was primarily governed by the behavior of the child. No specific time limit was imposed. If fixation consistently occurred, the session often took five minutes or less to complete. However, some sessions were quite lengthy when the stimulus was presented three or more times for one trial. Some sessions required 15 to 20 minutes to complete. Previous research indicates that training for eye control is very tiring and activity sessions should be short, therefore perhaps a time limit should be placed on testing sessions.

The procedures presented in this study proved to be reliable measures of assessing visual tracking skills. Additional research would provide further validity to this method of testing and perhaps provide guidance for utilizing the measures obtained with this assessment.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE VISUAL SCANNING AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interboserver Reliability Results and Pilot Data with One Nonhandicapped and Three Handicapped Children[1]

by

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and

Cynthia M. Janssen

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[1] The procedures and data reported in this study were taken from a Master's thesis by Leslie W. Fernandez that was submitted to the Department of Special Education, University of Kansas, in May, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages VO(S) 1 to VO(S) 14 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to mesure the frequency and mean frequency of visual contacts with preferred objects in the scan path when the student was in a sitting, prone, or sidelying position. Scan path was defined as the grid sections which the student's eyes visually contacted A 3' x 3' plexiglass grid, divided into nine sections, was used to arrange stimulus items into various arrays: two objects horizontally, two objects vertically, two objects diagonally, three objects horizontally, three objects vertically, three objects diagonally, and three objects randomly placed. Each of these arrays was tested in two distances from the child: grid 6"-12" from child and grid 18"-24" from child.

For each trial the grid was masked and placed directly in front of the child with the examiner directly in front of the child and grid in order to clearly view the child's eyes. A trial began when the grid was unmasked and the student was instructed to look and ended after 15 seconds had elapsed. The frequency of visual contacts with each object in the array was recorded during each 15 second trial. Each student was tested in at least two positions with four observation sessions per position.

Subjects

This study included both multiply handicapped individuals and a nonhandicapped infant. Selection criteria included: (a) useable vision, and (b) demonstration of some scanning abilities.

Subject 1. M.E. was a 18 year old male with congenital rubella syndrome. He was ambulatory and functionally deaf. He had surgical aphakia (absence of the eye lens), nystagmus in both eyes, and wore cataract glasses. Although legally blind, he could read size 12-point print. According to the Callier-Azusa Scale (Stillman, 1978), he was functioning at the 60 month (ceiling) level visually and at the 55 month level for visual motor skills.

Subject 2. T.G. was a 16 year old male with arrested hydrocephalus, spastic quadriplegia, and scoliosis. He was hypotonic and functionally nonambulatory. He had been diagnoised as cortically blind based on non-responsiveness during testing. According to the Callier-Azusa Scale (Stillman, 1978) he was functioning at the 6 month level visually and at the 7 month level for visual motor skills.

Subject 3. K. H. was a 6 year old female with multiple congenital deformities. She was ambulatory and had a sensorineural hearing loss in both ears. She was legally blind and had bilateral colobomas (defeat of ocular tissue affecting the eyelids, ciliary body, lens or iris generally caused by failure of fetal fissure to close). She also had congenital alternating esotropia (inward deviation of the visual axis of one eye when the other eye was fixating). According to the Callier-Azusa Scale (Stillman, 1978), she was functioning at the 18 month level visually and at the 24 month level for visual motor skills.

Subject 4. G. B. O. was a normally developing male who was observed from six to seven months of age.

Procedures for Obtaining Measures of Reliability

Reliability was recorded and computed in the same manner for each position in which visual scanning was measured. Two examiners were positioned directly in front of the subject and the grid, as close to one another as possible, so that each could clearly view the subject's face from approximately the same angle. Each examiner recorded the frequency of visual contacts with stimulus objects and the mean frequency of visual contacts with stimulus objects for each trial. The examiners observed only the subject and did not consult with one another during the trial. Upon completion of a session, reliability was determined for each trial and for the total session. Reliability was computed according to the following formula:

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements} + \text{number of disagreements}}$$

Three methods of recording reliability scores were taken: (1) mean reliability scores for subjects by position, (2) mean reliability scores for subjects by visual array, and (3) mean reliability scores for individual subjects by position, array and grid distance.

Results

This section presents interobserver reliability data for each of the three positions (sitting, prone, and sidelying) and mean frequencies of visual contacts with objects by subject. All reliability and percentage scores were computed to one decimal place and rounded off to the nearest whole number. Frequency scores were computed to three decimal places and rounded off to two decimal places.

Subject 1. The reliability scores for each session are presented in Table 1. These scores are presented separately for sitting and sidelying. In sitting the scores ranged from 94% to 100% with a mean score of 97%. The reliability scores in sidelying ranged from 96% to

Table 1

Reliability Scores of Visual Scanning by Subject and Position

	Sitting		Prone		Sidelying		
Subject	Reliability per Session	Mean Reliability	Reliability per Session	Mean Reliability	Reliability per Session	Mean Reliability	Total Mean Reliability
1	94	97			98	97	97
	96				96		
	98				98		
	100				96		
2	96	95	92	96	98	97	96
	94		98		98		
	98		92		96		
	92		100		96		
3	100	99	98	98			98
	98		98				
	98		100				
	98		96				
4	100	98	98	96			97
	98		96				
	98		96				
	96		94				
1-4		97		97		97	

98% with a mean score of 97%. Reliability scores across positions for different visual arrays are presented in Table 2. These reliability scores ranged from 94% to 100%. Reliability scores for the nine arrays in sitting and sidelying at both grid positions are presented in Table 3. These reliability scores ranged from 84% to 100%.

Mean frequency of visual contacts across positions is presented in Figure 1. These scores ranged from .72 visual contacts to 1.31 visual contacts.

Subject 2. The reliability scores for each session are presented in Table 1. These scores are presented separately for sitting, sidelying, and prone positions. Scores in sitting ranged from 92% to 98% with a mean score of 95%. Scores in sidelying ranged from 96% to 98% with mean score of 97%. Reliability scores in prone ranged from 92% to 100% with a mean score of 96%. Reliability scores across positions for different visual arrays are presented in Table 2. These reliability scores ranged from 92% to 99% with a mean score of 96%. Reliability scores for the nine arrays in sitting, sidelying, and prone positions at both grid distances are presented in Table 4. These reliability scores ranged from 75% to 100%.

Mean frequency of visual contacts with objects is presented in Figure 2. These scores ranged from .67 visual contacts to 1.25 visual contacts.

Subject 3. The reliability scores for each session are presented in Table 1. These scores are presented separately for sitting and prone positions. The reliability scores in sitting ranged from 98% to 100% with a mean score of 99%. Session scores in prone position ranged from 96% to 100% with a mean score of 98%. Reliability scores across positions for

Table 2

Mean Reliability Scores of Visual Scanning by Subject and Visual Arrays Across Positions

Subject	Visual Arrays								
	2-object horizontal	3-object horizontal	2-object vertical	3-object vertical	2-object (l-r) diagonal	3-object (l-r) diagonal	2-object (r-l) diagonal	3-object (-l) diagonal	random
1	97	98	97	96	100	96	94	98	94
2	94	97	98	99	96	93	92	97	96
3	100	94	100	100	100	100	94	96	100
4	100	94	98	98	100	94	100	98	94
1-4	98	97	97	98	99	96	95	97	96

Table 3

Mean Reliability Scores of Four Observations of Visual Scanning for Subject 1

Visual Array	Sitting		Sidelying	
	near	far	near	far
2-object horizontal	100	100	88	100
3-object horizontal	100	100	100	92
2-object vertical	88	100	100	100
3-object vertical	92	100	100	92
2-object (l-r) diagonal	100	100	88	88
3-object (l-r) diagonal	92	92	100	100
2-object (r-l) diagonal	100	100	100	100
3-object (r-l) diagonal	100	100	100	92
random	84	100	100	92
all arrays	94	98	96	96

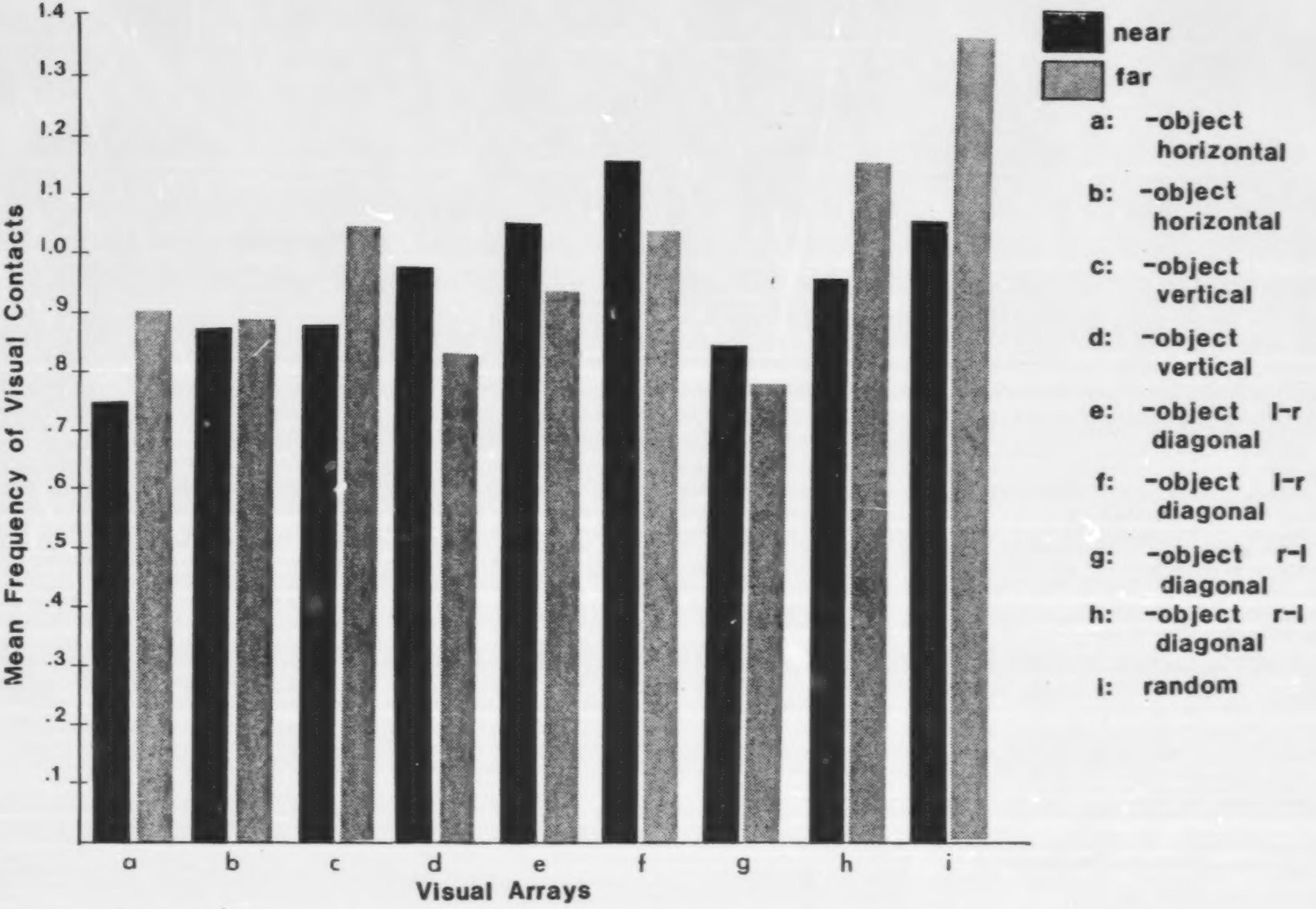

Figure 1 : Mean Frequencies of Visual Contacts of Subject 1

Table 4

Mean Reliability Scores of Four Observations of Visual Scanning for Subject 2

Visual Array	Sitting		Prone		Sidelying	
	near	far	near	far	near	far
2-object horizontal	100	88	100	100	100	100
3-object horizontal	92	100	100	100	100	92
2-object vertical	100	100	100	88	100	100
3-object vertical	100	100	100	100	92	100
2-object (l-r) diagonal	88	100	100	88	100	75
3-object (l-r) diagonal	100	92	92	100	100	92
2-object (r-l) diagonal	100	100	100	88	100	100
3-object (r-l) diagonal	92	92	100	100	75	100
random	100	92	92	100	100	92
all arrays	97	96	98	96	96	95

VO(S)11

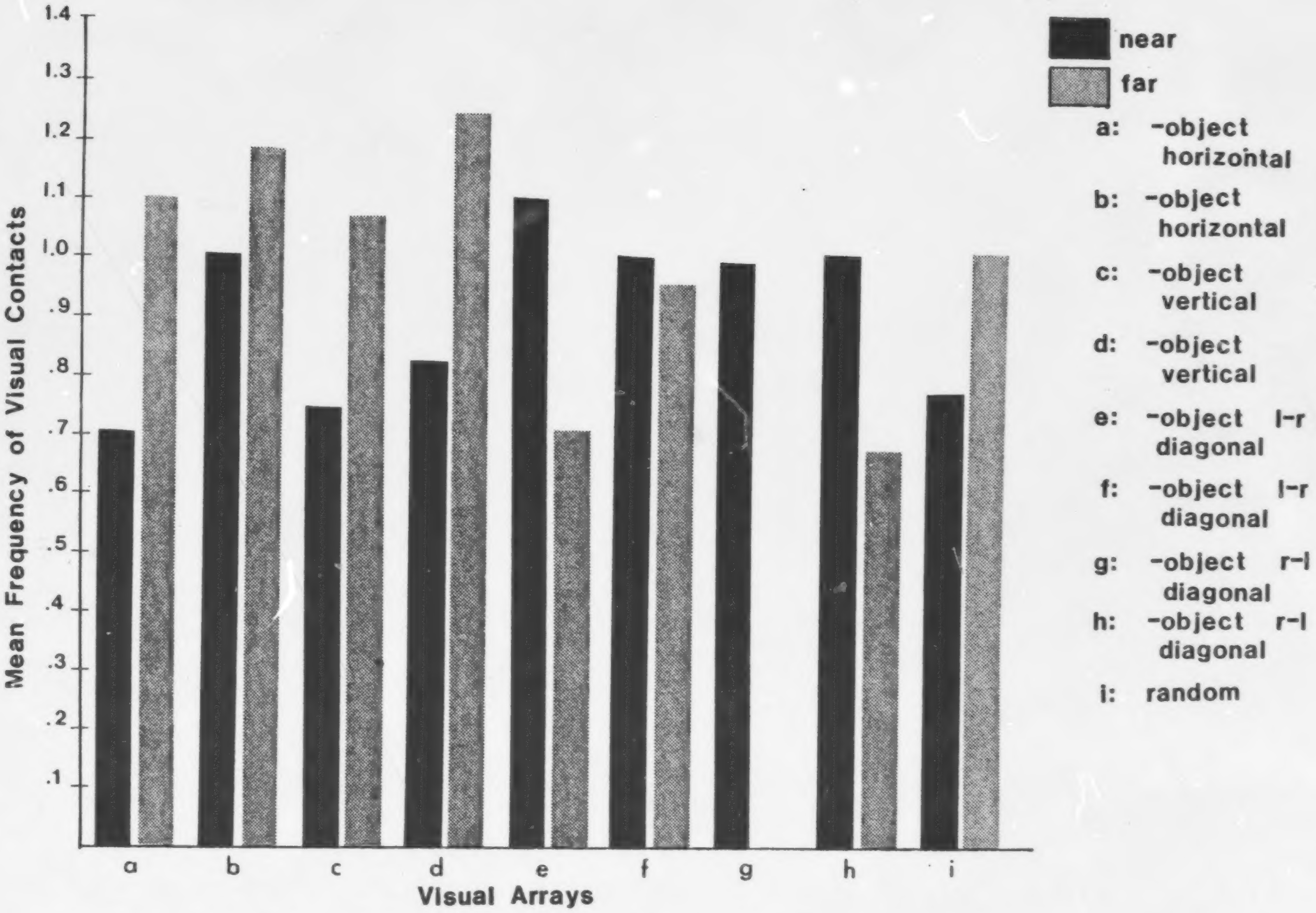

Figure 2 : Mean Frequencies of Visual Contacts of Subject 2

different visual arrays are presented in Table 2. These scores ranged from 94% to 100%. Reliability scores for the nine arrays in sitting and prone positions at both grid distances are presented in Table 5. These scores ranged from 63% to 100%.

Mean frequency of visual contacts across positions is presented in Figure 3. These scores ranged from .75 visual contacts to 1.40 contacts.

Subject 4. The reliability scores for each session are presented in Table 1. These scores are presented separately for sitting and prone positions. The reliability scores in sitting ranged from 96% to 100% with a mean score of 98%. Session scores in prone position ranged from 94% to 98% with a mean score of 96%. Reliability scores across positions for different visual arrays are presented in Table 2. These scores ranged from 94% to 100%. Reliability scores for the nine visual arrays in sitting and prone positions at both grid distances are presented in Table 6. These reliability scores ranged from 75% to 100%.

Mean frequency of visual contacts across positions are presented in Figure 4. These scores ranged from .31 to .90 visual contacts.

All Subjects. Mean reliability scores for the three positions across subjects are presented in Table 1. Mean reliability scores for the different visual arrays across subjects are presented in Table 2.

Discussion

The interboserver reliability data collected on the three handicapped children and one nonhandicapped infant tested in the sitting, prone, and sidelying positions indicate that this measurement procedure provides a reliable tool for assessing visual contacts with objects in various scan paths.

Table 5

Mean Reliability Scores of Four Observations of Visual Scanning for Subject 3

Visual Array	Sitting near	Sitting far	Prone near	Prone far
2-object horizontal	100	100	100	100
3-object horizontal	92	100	84	100
2-object vertical	100	100	100	100
3-object vertical	100	100	100	100
2-object (l-r) diagonal	100	100	100	64
3-object (l-r) diagonal	92	92	100	100
2-object (r-l) diagonal	100	100	100	100
3-object (r-l) diagonal	100	100	100	100
random	100	100	100	100
all arrays	98	99	98	96

VO(S)14

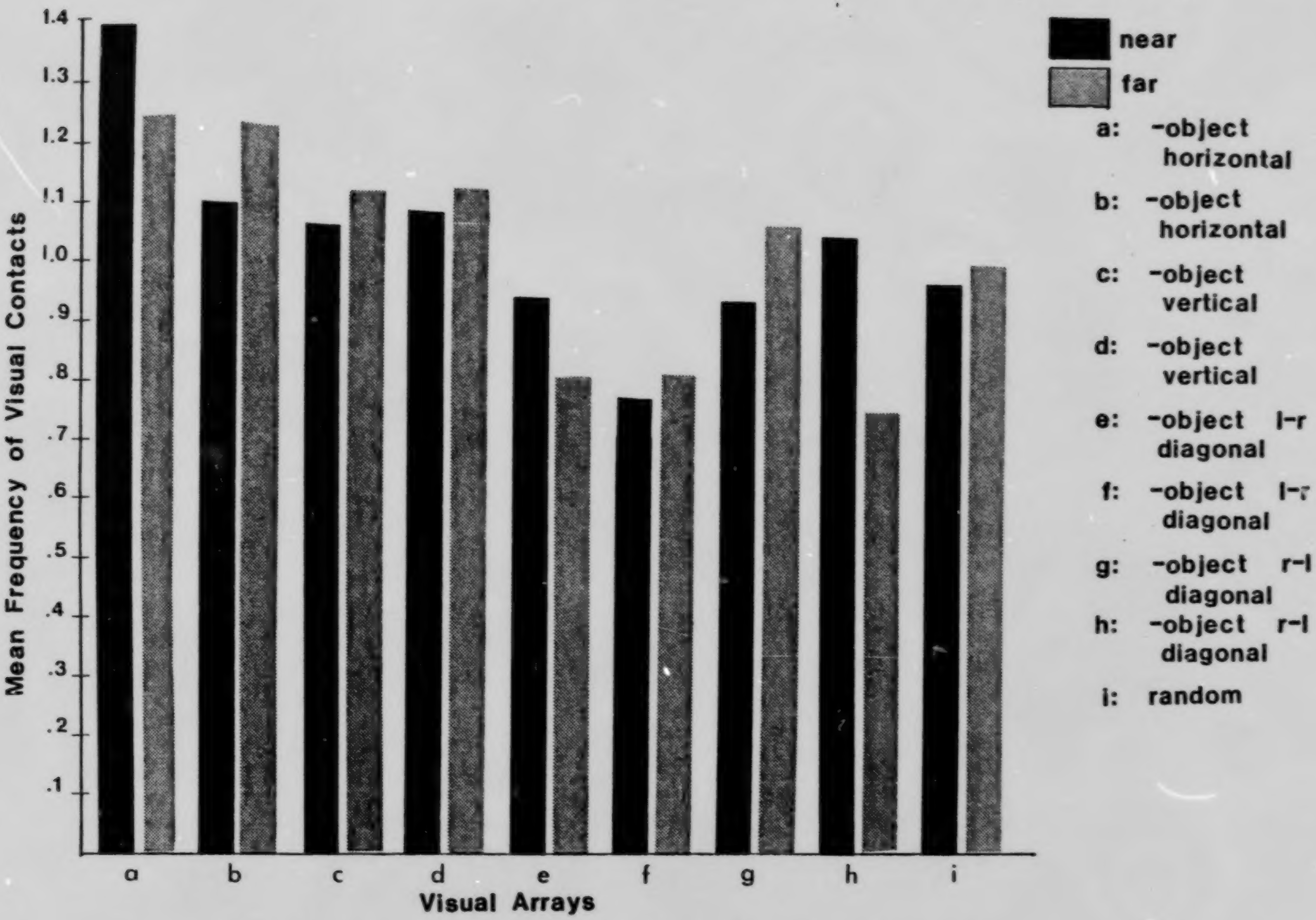

Figure 3 : Mean Frequencies of Visual Contacts of Subject 3

Table 6

Mean Reliability Scores of Four Observations of Visual Scanning for Subject 4

	Sitting		Prone	
Visual Array	near	far	near	far
2-object horizontal	100	100	100	100
3-object horizontal	100	100	100	92
2-object vertical	88	88	100	100
3-object vertical	92	100	100	100
2-object (l-r) diagonal	100	100	100	100
3-object (l-r) diagonal	100	100	100	92
2-object (r-l) diagonal	100	100	100	100
3-object (r-l) diagonal	100	100	100	75
random	92	100	100	84
all arrays	98	99	100	90

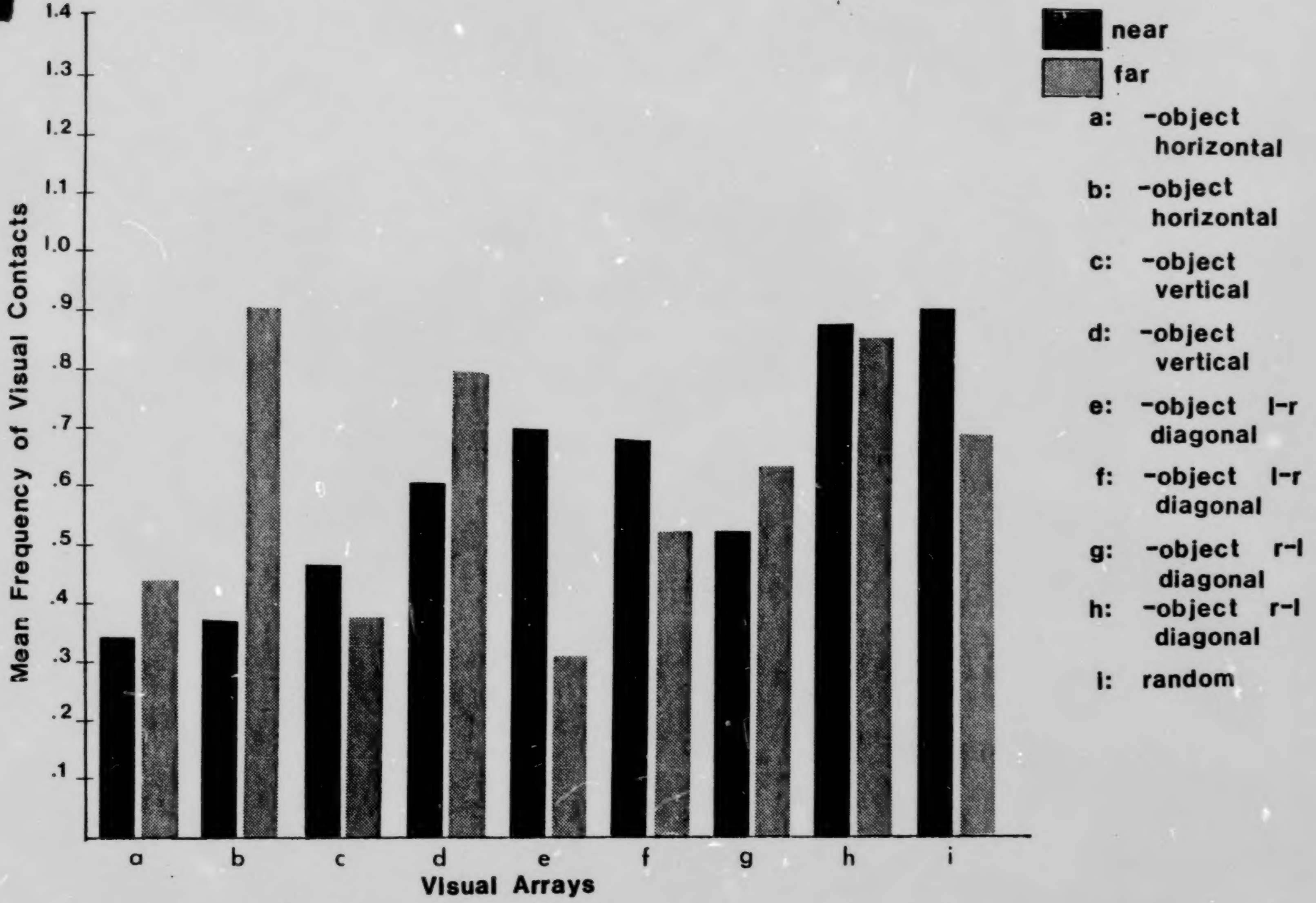

Figure 4 : Mean Frequencies of Visual Contacts of Subject 4

Originally, measurement of scanning included noting the complete scan path of the subject. This entailed noting all grid sections with which the subject made visual contact and in the correct order. Although operationally defined and quantifiably measured, this system offered very poor reliability because of the amount of data to record and the tendency to look at the data recording sheet rather than the subject. It was very difficult to use with a subject who rapidly looked from grid section to grid section. This system evolved into measuring only the frequency of visual contacts with objects on the grid. Although scan path is not recorded, subject's visual patterns can be inferred from array patterns.

There does not seem to be any correlation between a lower reliability score and a lower scanning performance. Nor does grid postion appear to affect reliability scores or scanning performance. All subjects had visual arrays with mean frequencies higher in both grid positions, therefore grid distance appears to have little affect on scanning abilities.

The visual impairments of subjects 1, 2, and 3 did not appear to affect the reliability scores of the sessions. Although both subjects 1 and 3 had impairments that could affect the examiner's perception of where the subject was looking, their reliability scores indicate that this was not the case. This could be attributed to the large size of the grid sections. Smaller grid sections would increase the probability of a more refined measurement system, but could decrease reliability measures. This could be one focus of future research.

These measurement procedures should be used to collect data on both handicapped and nonhandicapped subjects on a longitudinal basis. Data will provide information about acquiston rate and visual patterns. Simulataneous data collection on both populations will indicate similarities and/or differences in the development of this visual skill.

Future research could indicate whether or not the vertical plane is optimal for presenting the grid, or whether it should be presented on a horizontal plane. It could also indicate whether or not this measurement system will reliably measure scanning of handicapped individuals with normal vision.

Consideration should also be given to changing the stimulus presentation for each student so that he/she does not become bored. Perhaps increasing the number of stimulus items could accomplish this.

Continuous application of these measurement procedures could provide teachers with a more sensitive measure to determine the effectiveness of their teaching strategy. Such measures as scanning percentages and mean frequencies by visual array would indicate visual patterns that teachers could use in all other training, i.e. presentation of stimulus items for discrimination training, etc.

As other sensory motor measurement methods are developed it can be determined whether one skill is influenced by the acquistion of other behaviors. This will indicate whether or not skills follow a maturationally determined sequence of development. It will require the continuous measurement of all the subcomponent parts in a sequence from the initial skill, i.e., visual fixation, through the terminal skill, i.e., visual scanning.

Additionally, longitudinal collection and analysis of data on visual scanning is necessary in order to determine whether or not this measurement system is more sensitive to the emergence and development of skills than the standardized and criterion-referenced assessments presently available to teachers of this population.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE REACH BEHAVIOR AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped Infant and Four Handicapped Preschooers[1]

by

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and

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[1] The procedures and data reported in this study were taken from a Master's thesis by Deborah D. Proctor submitted to the Department of Special Education at the University of Kansas, October, 1979.

Overview of the Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages FM(R) 1 through FM(R) 38 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to measure the behaviors involved in a reach response. They were demonstrated on children in four different body positions: sitting and supported sitting, sidelying, supine, and standing. Measures were taken on the topography of the reach response across six different stimulus positions in each measurement session.

The behaviors measured in the topography of the reach response were: if arm movement occurred, if this movement resulted in contact with the stimulus item, if the contact was a result of direct or indirect movement, whether contact with the supporting surface was made during the reach response, and how long it took the child to contact the stimulus item after it was presented. The six stimulus positions included a near and a far position to the child's left, middle, and right. The distance of the stimulus object was determined by the child's own arm length. The near position was half the length of the child's arm from the shoulder to the joints indicating the beginning of the fingers on the hand (the metacarpal-phalgeal joints). The far position was the full length of the child's arm from the shoulder to the same joints. A session included eighteen trials, three trials per stimulus object position. Each child was observed in one or two of his/her most functional body positions across four observation sessions.

The procedures involved a series of activities to draw the child's attention to the stimulus object. The experimenter could continue to present auditory or visual cues throughout the length of the trial.

The trial continued for as long as the child continued to move his/her arm. A trial terminated with contact with the object by either the right or left hand, or a span of two seconds without arm movement in the right or left arms. At the end of the trial, the reach responses were each scored as an occurrence/nonoccurrence on the data sheet.

Subjects

This study included four preschool-aged multiply handicapped children and one normally developing infant. Three of the subjects were selected from a preschool program in a public school system and one subject was selected from the Preschool for the Severely Multiply Handicapped located at the Kansas University Medical Center. Selection criteria were based on a lack of direct, consistent reaching behaviors.

Subject 1. Mary was a normally developing three month old female.

Subject 2. Matthew was as four year old male with a diagnosis of spastic quadriparesis, congenital cleft palate, and severe developmental delay. On the mental scale of the Bayley Scales of Infant Development, Matthew appeared to be functioning below the four and one half month level. Matthew had poor head and trunk control, did not roll over or sit independently, and had little consistent upper extremity movement.

Subject 3. Margie was a five year old female with a diagnosis of spastic quadriparesis and severe developmental delay. According to the mental scale of the Bayley Scales of Infant Development, Margie appeared to be functioning below the seven month level. Margie rolled independently, sat unsupported for short periods of time, but did not have complete head to trunk control, and could not crawl or stand. Margie reached indirectly and inconsistently, grasped objects for a few seconds with a palmar grasp, but did not transfer objects from hand to hand.

Subject 4. Daniel was a one year old male with a diagnosis of spastic quadriparesis and cortical blindness who appeared to be functioning at the three and one half month level on the mental scale of the Bayley Scales of Infant Development. Daniel visually fixated inconsistently on bright objects, rolled from prone to supine, but did not have the head and trunk control needed for independent sitting. He moved his upper extremities with little direction, grasped objects briefly with a palmar grasp, but did not transfer objects from hand to hand.

Subject 5. Tony was a four year four month old male with a diagnosis of athetoid cerebral palsy and severe developmental delay. According to the mental scale of the Bayley Scales of Infant Development, he appeared to be functioning at the ten month level. He rolled independently, sidesat for short periods with support, but was unable to crawl, kneel, or stand. Tony reached indirectly but consistently, grasped objects for a few seconds, but did not transfer objects from hand to hand.

Procedure for Obtaining Measures of Reliability

Measures of reliability for all positions (sidelying, sitting, supine, and standing) were taken by a biased and an unbiased observer. A biased observer was a person who had formal training in the area of understand behavioral definitions, observing behavior, and taking data. Typically, this include persons from a background in special education, occupational or physical therapy, psychology, or human development. An unbiased observer was a person without formal training in the above mentioned areas. Typically, the unbiased observer include classroom aides, parents, siblings, etc.

The observer sat next to the examiner with a clipboard, data sheet, pencil, and stopwatch. During the trials, the observer could move around as needed for a good view of the child's movement. The observer often assisted the examiner in activating the toy during the stimulus presentation if the examiner was having difficulty maintaining the child's position and/or attention. Once timing had begun, there was no verbal discussion between the observer and the examiner. When the trial was over, the examiner and the observer independently recorded performances on the data sheet. There was no discussion about what was observed until after the data sheet was filled out for each trial or until after the session was completed. On trials when the child was noncompliant or obviously not attending to the stimulus, the examiner discontinued the trial and neither the examiner nor the observer recorded the observations. The formula used to compute reliability between observers and the examiner for each child in each body position was:

$$\frac{\text{\# of agreements}}{\text{\# of disagreements + agreements}} \times 100 = \text{reliability}$$

For each behavior that had an opportunity to be scored, the number of agreements was divided by the number of agreements plus the number of disagreements and multiplied by 100 to obtain the reliability score for each trial. The sum of the reliability scores for each trial in each session was summed and divided by the total number of trials to calculate the overall reliability for each session.

Results

The reliability tables (Tables 1 through 8) are arranged so that there are three levels of descriptors across the top of the page. This arrangement displays the hierarchy of the descriptors taken from the raw data sheets. Level one of the hierarchy consists of the following discriptors: Movement, No Movement, Right/Left, and Time. Under Movement, at level two, there is Contact or No Contact. At level three under Movement with Contact there is On/Off the surface and Direct/Indirect movement. Also, at level three under Movement with No Contact there is Direct/Indirect movement. Listed down the left side of the table are the six stimulus positions with separate reliability data available for the right (R) and left (L) hands.

These tables generate several types of reliability. Each intersection of a row and column shows two numbers. The top fraction is the actual number of agreements over number of agreements plus disagreements for each descriptor in each stimulus positon for four sessions (12 trials) of observations of one child in one body position. The bottom number is this ratio expressed as percentage. Moving horizontally, from left to right, in each stimulus position, reliability for the right or left hand across all descriptors is found in the column marked right/left reliability (R/L). Here, agreements over agreements plus disagreements for the time descriptor is counted for each hand. Reliability for both the right and left hands combined for each stimulus position across all descriptors is found under the column marked Row Reliability. (Time reliability data are included only once in the (R/L) reliability measure.) Mean reliability percentages for each descriptor across all stimulus positions and right and left hands for the four sessions of data in one body position are found in the row marked Column Mean Reliability. The number at the far bottom right is the grand mean reliability across all stimulus position and all descriptors for four sessions per body position.

Subject 1 (Mary)

Supine position. Table 1 represents the reliability information for the measurement of reach for Subject 1 in the supine position. The first column

Table 1

Reliability Scores for Subject 1
in the Supine Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	NA	None	12/12[1] (100)[2]	None	24/24 (100)	12/12 (100)	36/36 (100)
Far	L	NA	None	12/12 (100)	None	24/24 (100)		
Right	R	NA	10/10 (100)	2/2 (100)	None	24/24 (100)	12/12 (100)	36/36 (100)
Near	L	NA	None	12/12 (100)	None	24/24 (100)		
Mid	R	NA	None	11/11 (100)	1/1 (100)	24/24 (100)	12/12 (100)	36/36 (100)
Far	L	NA	None	11/11 (100)	1/1 (100)	24/24 (100)		
Mid	R	NA	6/6 (100)	6/6 (100)	None	22/24 (92)	10/12 (83)	34/36 (94)
Near	L	NA	None	12/12 (100)	None	22/24 (92)		
Left	R	NA	None	12/12 (100)	None	24/24 (100)	12/12 (100)	36/36 (100)
Far	L	NA	1/1 (100)	11/11 (100)	None	24/24 (100)		
Left	R	NA	None	11/12 (92)	None	23/24 (96)	12/12 (100)	34/36 (94)
Near	L	NA	7/8 (87.5)	4/4 (100)	None	23/24 (96)		
Column Reliab			97%	99%	100%		97%	98%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

on the left under On/Off the surface is not applicable due to no testing surface in the supine position. When movement produced contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 87.5% to 100% with an average of 97%. When movement resulted in no contact with the stimulus item, the reliability on whether or not the movement was direct or indirect ranged from 92% to 100% with an average of 99%. The two observers agreed with 100% reliability when no movement occurred upon stimulus presentation. Under the time descriptor, the reliability ranged from 83% to 100% with an average of 97%. The reliability across all descriptors for each stimulus position for the right and left hands taken separately ranged from 92% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 94% to 100% with a total average reliability of 98%.

Subject 2 (Matthew)

Sidelying position. Table 2 represents the reliability information for the measurement of reach for Subject 2 in the sidelying position. When movement produced contact with the stimulus object, the reliability on whether or not his hand was on or off the testing surface during the approach movement ranged from 0% to 100% with an average of 60% and the reliability on whether or not the movement was direct or indirect ranged from 0% to 100% with an average of 80%. When movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 66% to 100% with an average of 90%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 75% to 100% with an average of 95%. Under the time descriptor, the reliability across stimulus positions

Table 2

Reliability Scores for Subject 2
in the Sidelying Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Eyes	R	None	None	4/5[1] (80)[2]	7/7 (100)	23/24 (96)	12/12 (100)	35/36 (97)
Far	L	None	None	10/10 (100)	2/2 (100)	24/24 (100)		
Eyes	R	1/1 (100)	0/1 (0)	None	11/11 (100)	24/25 (96)	12/12 (100)	35/37 (95)
Near	L	None	None	6/7 (86)	5/5 (100)	23/24 (96)		
Chest	R	None	None	2/3 (66)	9/9 (100)	23/24 (96)	12/12 (100)	34/36 (94)
Far	L	None	None	8/8 (100)	3/4 (75)	23/24 (96)		
Chest	R	0/1 (0)	1/1 (100)	2/2 (100)	7/9 (78)	22/25 (88)	12/12 (100)	35/38 (92)
Near	L	1/1 (100)	1/1 (100)	8/8 (100)	3/3 (100)	25/25 (100)		
Stomach	R	None	None	4/4 (100)	8/9 (89)	23/24 (96)	12/12 (100)	34/36 (94)
Far	L	None	None	9/10 (90)	2/2 (100)	23/24 (96)		
Stomach	R	0/1 (0)	1/1 (100)	2/3 (66)	8/8 (100)	23/25 (92)	12/12 (100)	36/38 (95)
Near	L	1/1 (100)	1/1 (100)	9/9 (100)	2/2 (100)	25/25 (100)		
Column Reliab		60%	80%	90%	95%		100%	94.5%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as percentage.

was 100%. The reliability across all descriptors for each stimulus positon for the right and left hands taken separately ranged from 88% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 92% to 97% with a total average reliability of 94.5%.

Supported sitting position. Table 3 represents the reliability information for the measurement of reach for Subject 2 in a supported sitting position. When movement produced contact with the stimulus object, the reliability on whether or not his hand was on or off the testing surface during the approach movement ranged from 0% to 100% with an average of 57% and the reliability on whether or not the movement was indirect or direct ranged from 0% to 100% with an average of 72.5%. When the movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 66% to 100% with an average of 83.7%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 60% to 100% with an average of 96%. Under the time descriptor, the reliability across all descriptors for each stimulus position with the right and left hands taken separately ranged from 79% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 76% to 97% with a total average reliability of 92%.

Subject 3 (Margie)

Supine position. Table 4 represents the reliability information for the measurement of reach for Subject 3 in the supine position. The first column at the far left under On/Off the surface is not applicable due to

Table 3

Reliability Scores for Subject 2 in the Supported Sitting Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	1/1[1] (100)[2]	0/1 (0)	5/7 (75)	4/4 (100)	22/25 (88)	12/12	34/37
Far	L	None	None	7/7 (100)	5/5 (100)	24/24 (100)	(100)	(92)
Right	R	0/1 (0)	1/1 (100)	4/4 (100)	7/7 (100)	24/25 (96)	12/12	36/37
Near	L	None	None	6/6 (100)	6/6 (100)	24/24 (100)	(100)	(97)
Mid	R	None	None	5/7 (71)	5/5 (100)	22/24 (92)	12/12	35/37
Far	L	1/1 (100)	1/1 (100)	8/8 (100)	3/3 (100)	25/25 (100)	(100)	(95)
Mid	R	2/5 (40)	3/5 (60)	2/2 (100)	5/5 (100)	24/29 (83)	12/12	34/45
Near	L	2/4 (50)	3/4 (75)	2/3 (66)	3/5 (60)	22/28 (79)	(100)	(76)
Left	R	None	None	4/4 (100)	8/8 (100)	24/24 (100)	12/12	35/36
Far	L	None	None	2/2 (100)	9/10 (90)	23/24 (96)	(100)	(97)
Left	R	None	None	None	12/12 (100)	24/24 (100)	12/12	39/42
Near	L	3/6 (50)	6/6 (100)	None	6/6 (100)	27/30 (90)	(100)	(93)
Column Reliab		57%	72.5%	83.7%	96%		100%	92%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

Table 4

Reliability Scores for Subject 3 in the Supine Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	NA	None	9/10[1] (90)[2]	2/2 (100)	23/24 (96)	12/12 (100)	34/36 (94)
Far	L	NA	2/2 (100)	9/10 (90)	None	23/24 (96)		
Right	R	NA	None	10/10 (100)	1/2 (50)	22/24 (92)	11/12 (92)	34/36 (94)
Near	L	NA	10/10 (100)	2/2 (100)	None	23/24 (96)		
Mid	R	NA	None	6/6 (100)	4/6 (67)	21/24 (87.5)	11/12 (92)	33/36 (92)
Far	L	NA	5/5 (100)	6/6 (100)	1/1 (100)	23/24 (96)		
Mid	R	NA	None	6/7 (86)	5/5 (100)	23/24 (96)	12/12 (100)	35/36 (97)
Near	L	NA	10/10 (100)	2/2 (100)	None	24/24 (100)		
Left	R	NA	None	7/7 (100)	2/5 (40)	21/24 (87.5)	12/12 (100)	31/36 (86)
Far	L	NA	3/3 (100)	5/7 (71)	2/2 (100)	22/24 (92)		
Left	R	NA	None	8/8 (100)	4/4 (100)	24/24 (100)	12/12 (100)	34/36 (94)
Near	L	NA	6/8 (75)	4/4 (100)	None	22/24 (92)		
Column Reliab			96%	95%	82%		97%	93%

[1] The ratio of the number of times the descriptor was used over the number of possibles uses.

[2] The ratio expressed as a percentage.

no testing surface in the supine position. When movement produced contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 75% to 100% with an average of 96%. When movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 71% to 100% with an average reliability of 95%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 40% to 100% with an average of 82%. Under the time descriptor, the reliability ranged from 92% to 100% with an average of 97%. The reliability across all descriptors for each stimulus position with the right and left hands taken separately ranged from 87.5% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 86% to 97% with a total average reliability of 93%.

Supported sitting position. Table 5 represents the reliability information for the measurement of reach for Subject 3 in a supported sitting position. When movement produced contact with the stimulus object, the reliability of whether or not the child's hand was on or off the testing surface during the approach movement ranged from 60% to 100% with an average of 81% and the reliability on whether or not the movement was indirect or direct ranged from 40% to 100% with an average of 76%. When movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 50% to 100% with an average of 88%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 0% to 100% with an average of 61%. Under the time descriptor, the reliability across stimulus positions was 100%. The reliability across

Table 5
Reliability Scores for Subject 3 in the Supported Sitting Position

		Movement			No Movement	Right/Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/Indirect	Direct/Indirect				
Right	R	None	None	11/11[1] (100)[2]	1/1 (100)	24/24 (100)	12/12 (100)	36/36 (100)
Far	L	None	None	11/11 (100)	1/1 (100)	24/24 (100)		
Right	R	3/5 (60)	2/5 (40)	7/7 (100)	None	24/29 (83)	12/12 (100)	37/45 (82)
Near	L	3/4 (75)	2/4 (50)	8/8 (100)	None	25/28 (89)		
Mid	R	None	None	10/11 (91)	0/1 (0)	22/24 (92)	12/12 (100)	36/38 (95)
Far	L	2/2 (100)	2/2 (100)	10/10 (100)	None	26/26 (100)		
Mid	R	None	None	7/9 (78)	2/3 (67)	21/24 (87.5)	12/12 (100)	41/46 (89)
Near	L	9/10 (90)	10/10 (100)	1/2 (50)	None	32/34 (94)		
Left	R	None	None	12/12 (100)	None	24/24 (100)	12/12 (100)	40/43 (93)
Far	L	5/7 (71)	6/7 (86)	5/5 (100)	None	28/31 (90)		
Left	R	None	None	10/11 (91)	0/1 (0)	22/24 (92)	12/12 (100)	39/45 (87)
Near	L	8/9 (89)	7/9 (78)	1/2 (50)	1/1 (100)	29/33 (88)		
Column Reliab		81%	76%	88%	61%		100%	91%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

all descriptors for each stimulus position with the right and left hands taken separately ranged from 83% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 82% to 100% with a total mean reliability of 91%.

Subject 4 (Daniel)

Supine position. Table 6 represents the reliability information for the measurement of reach for Subject 4 in a supine position. The first column on the left under On/Off the surface is not applicable due to no testing surface in the supine position. Whe movement produced contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 0% to 100% with an average of 88%. When movement resulted in no contact with the stimulus item, the reliability on whether or not the movement was direct or indirect ranged from 67% to 100% with an average of 92%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 0% to 100% with an average of 77%. Under the time descriptor, the reliability across stimulus positions was 100%. The reliability across all descriptors for each stimulus position with the right and left hands taken separately ranged form 79% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 81% to 100% with a total average reliability of 93%.

Supported sitting position. Table 7 represents the reliability information for the measurement of reach for Subject 4 in a supported sitting position. When movement produced contact with the stimulus object, the reliability on whether or not the child's hand was on or

Table 6

Reliability Scores for Subject 4
in the Supine Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	NA	1/1[1] (100)[2]	8/9 (89)	0/2 (0)	21/24 (87.5)	12/12 (100)	32/36 (89)
Far	L	NA	None	8/8 (100)	3/4 (75)	23/24 (96)		
Right	R	NA	8/9 (89)	2/3 (67)	None	22/24 (92)	12/12 (100)	29/36 (81)
Near	L	NA	0/1 (0)	7/8 (87.5)	0/3 (0)	19/24 (79)		
Mid	R	NA	1/1 (100)	9/10 (90)	1/1 (100)	23/24 (96)	12/12 (100)	35/36 (97)
Far	L	NA	1/1 (100)	8/8 (100)	3/3 (100)	24/24 (100)		
Mid	R	NA	3/3 (100)	6/8 (75)	1/1 (100)	22/24 (92)	12/12 (100)	34/36 (94)
Near	L	NA	4/4 (100)	7/7 (100)	1/1 (100)	24/24 (100)		
Left	R	NA	None	10/10 (100)	2/2 (100)	24/24 (100)	12/12 (100)	35/36 (97)
Far	L	NA	1/1 (100)	7/7 (100)	3/4 (75)	23/24 (96)		
Left	R	NA	None	9/9 (100)	3/3 (100)	24/24 (100)	12/12 (100)	36/36 (100)
Near	L	NA	7/7 (100)	1/1 (100)	4/4 (100)	24/24 (100)		
Column Reliab			88%	92%	77%		100%	93%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

Table 7

Reliability Scores for Subject 4
in the Supported Sitting Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	None	None	6/6[1] (100)[2]	5/6 (83)	23/24 (96)	12/12 (100)	35/36 (97)
Far	L	None	None	9/9 (100)	3/3 (100)	24/24 (100)		
Right	R	3/4 (75)	4/4 (100)	5/6 (83)	1/2 (50)	25/28 (89)	12/12 (100)	35/40 (87.5)
Near	L	None	None	7/8 (87.5)	3/4 (75)	22/24 (92)		
Mid	R	2/2 (100)	2/2 (100)	9/9 (100)	0/1 (0)	25/26 (96)	12/12 (100)	41/42 (98)
Far	L	4/4 (100)	4/4 (100)	4/4 (100)	4/4 (100)	28/28 (100)		
Mid	R	3/3 (100)	0/3 (0)	6/7 (86)	1/2 (50)	20/27 (74)	10/12 (83)	35/45 (78)
Near	L	6/6 (100)	4/6 (66)	3/4 (75)	2/2 (100)	25/30 (83)		
Left	R	None	None	10/10 (100)	1/2 (50)	23/24 (96)	12/12 (100)	39/41 (95)
Far	L	5/5 (100)	4/5 (80)	3/3 (100)	4/4 (100)	28/29 (97)		
Left	R	None	None	12/12 (100)	None	24/24 (100)	12/12 (100)	38/40 (95)
Near	L	4/4 (100)	3/4 (75)	6/6 (100)	1/2 (50)	26/28 (93)		
Column Reliab		96%	74%	94%	69%		97%	92%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

off the testing surface during the approach movement ranged from 75% to 100% with an average of 96% and the reliability of whether or not the movement was direct or indirect ranged from 0% to 100% with an average of 74%. When movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 75% to 100% with an average of 94%. The two observers' agreement that no movement occurred upon stimulus presentation ranged from 0% to 100% with an average of 69%. Under the time descriptors, the reliability across stimulus positions ranged from 83% to 100% with an average of 97%. The reliability across all descriptors for each stimulus position for the right and left hands taken separately ranged from 74% to 100%. The reliability for the right and left hands together in each stimulus position across all descriptors (time counted once for each stimulus position) ranged from 78% to 98% with a total mean reliability of 92%.

Subject 5 (Tony)

Supported standing position. Table 8 represents the reliability information for the measurement of reach for Subject 5 in a supported standing position. When movement resulted in contact with the stimulus object, the reliability of whether or not his hand was on or off the testing surface during the approach movement ranged from 50% to 100% with an average of 78% and the reliability of whether or not the movement was direct or indirect ranged from 92% to 100% with an average of 99%. When movement resulted in no contact with the stimulus object, the reliability on whether or not the movement was direct or indirect ranged from 90% to 100% with an average of 97%. The two observers' agreement that no movement occurred upon stimulus presentation ranged

Table 8

Reliability Scores for Subject 5 in the Supported Standing Position

		Movement			No Movement	Right/ Left	Time	Row Reliability
		Contact		No Contact				
		On/Off	Direct/ Indirect	Direct/ Indirect				
Right	R	12/12[1] [2](100)	12/12 (100)	None	None	24/24 (100)	12/12	36/36
Far	L	None	None	8/8 (100)	4/4 (100)	24/24 (100)	(100)	(100)
Right	R	8/10 (80)	10/10 (100)	2/2 (100)	None	32/34 (94)	12/12	45/48
Near	L	1/2 (50)	2/2 (100)	10/10 (100)	None	25/26 (96)	(100)	(94)
Mid	R	None	None	8/8 (100)	4/4 (100)	24/24 (100)	12/12	46/48
Far	L	10/12 (83)	12/12 (100)	None	None	34/36 (94)	(100)	(96)
Mid	R	None	None	12/12 (100)	None	24/24 (100)	12/12	46/48
Near	L	10/12 (83)	12/12 (100)	None	None	34/36 (94)	(100)	(96)
Left	R	None	None	9/10 (90)	1/2 (50)	21/24 (87.5)	11/12	42/48
Far	L	9/12 (75)	12/12 (100)	None	None	32/36 (88)	(92)	(87.5)
Left	R	None	None	9/10 (90)	2/2 (100)	23/24 (96)	12/12	43/48
Near	L	9/12 (75)	11/12 (92)	None	None	32/36 (89)	(100)	(93)
Column Reliab		78%	99%	97%	87.5%		99%	94%

[1] The ratio of the number of times the descriptor was used over the number of possible uses.

[2] The ratio expressed as a percentage.

from 50% to 100% with an average of 87.5%. Under the time descriptor, the reliability across stimulus positions ranged from 92% to 100% with an average of 99%. The reliability across all descriptors for each stimulus position for the right and left hands taken separately ranged from 87.5% to 100%. The reliability for the right and left hands together in each stimulus positon across all descriptors (time counted once for each stimulus position) ranged from 87.5% to 100% with a total average reliability of 94%.

Performance Data on Reach Responses

Five bar graphs per body positon are arranged in a hierarchy by descriptors. The data of those children tested in two body positons are presented. Horizontally at the top of each set of graphs are the six stimulus positions with left (L) and right (R) hand data under each stimulus position. Five graphs represent the following behaviors per subject in each position: (a) movement as the percentage of total trials presented; (b) contact, as the percentage of movement trials; (c) direct, as the percentage of movement trials; (d) off surface, as the percentage of contact trials; and (e) time, as the percentage of contact trials. These descriptors were chosen to be graphed because they represent the components of a mature or well-developed reach. Horizontally at the bottom of each set of graphs are the six time categories in second (0-3, 3-6, 6-9, 9-12, 12-15, and over 15) possible for each stimulus position.

The data graphed in these figures are presented in Tables 9 through 16 of appendix A.

Subject 1 (Mary)

Supine position. Figure 1 represents the reach response of Subject 1 in the supine position. Upon stimulus presentation, Mary moved both upper extremities 100% of the time in every stimulus position except

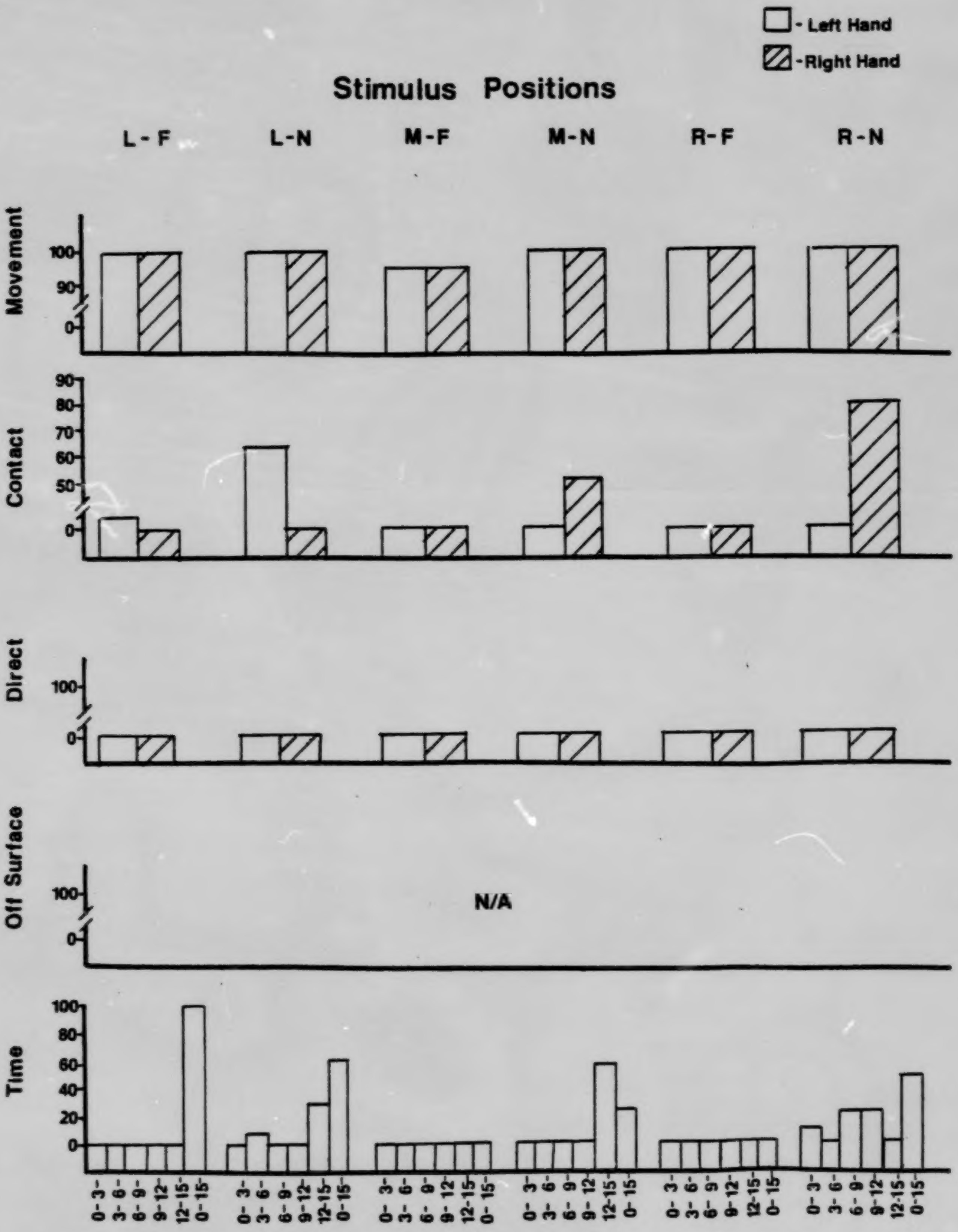

Figure 1: Reach Performance of Subject 1 in Supine

mid far, which was near 90%. That movement rarely resulted in contact with the stimulus object when it was at the far stimulus positions. Mary, however, had more success at touching the object when it was at the near distances, this typically was accomplished with the hand nearest the object. For example, the left hand touched an object in the left near position 68% of the time and the right hand touched objects in the right near position 85% of the time. It was more difficult for Mary to move either hand to midline, but she did have success 50% of the time in moving her right hand to objects in the mid near distance. None of Mary's upper extremity movements were ever direct in nature. When the toy was in the far distances, the contacts made generally took over 15 seconds. At the near distances, Mary took less time to contact the stimulus object. In the left near position, she contacted the toy 12% of the time in 3-6 seconds, 30% of the time in 12-15 seconds and 63% of the time in over 15 seconds. In the right near position, Mary took 0-3 seconds 10% of the time, 6-9 and 9-12 seconds 20% of the time, and over 15 seconds 50% of the time to contact objects.

Subject 2 (Matthew)

Sidelying position. Figure 2 represents the reach response of Subject 2 in the sidelying position. In this position, Matthew moved his left upper extremity (UE) considerably more than his right. When the toy was presented in the stomach far, stomach near, chest near, and eyes far stimulus positions, Matthew moved his left UE approximately 80% of the time. Movement with his left UE in other stimulus positions ranged from 58% to 66%. Matthew's quantity of left UE movement, however, resulted in contact with the toy only 0% to 11% of the time in all stimulus positions. Movement with the right UE ranged from 8% to 42%, but resulted in contact more often than with the left, especially in the near stimulus

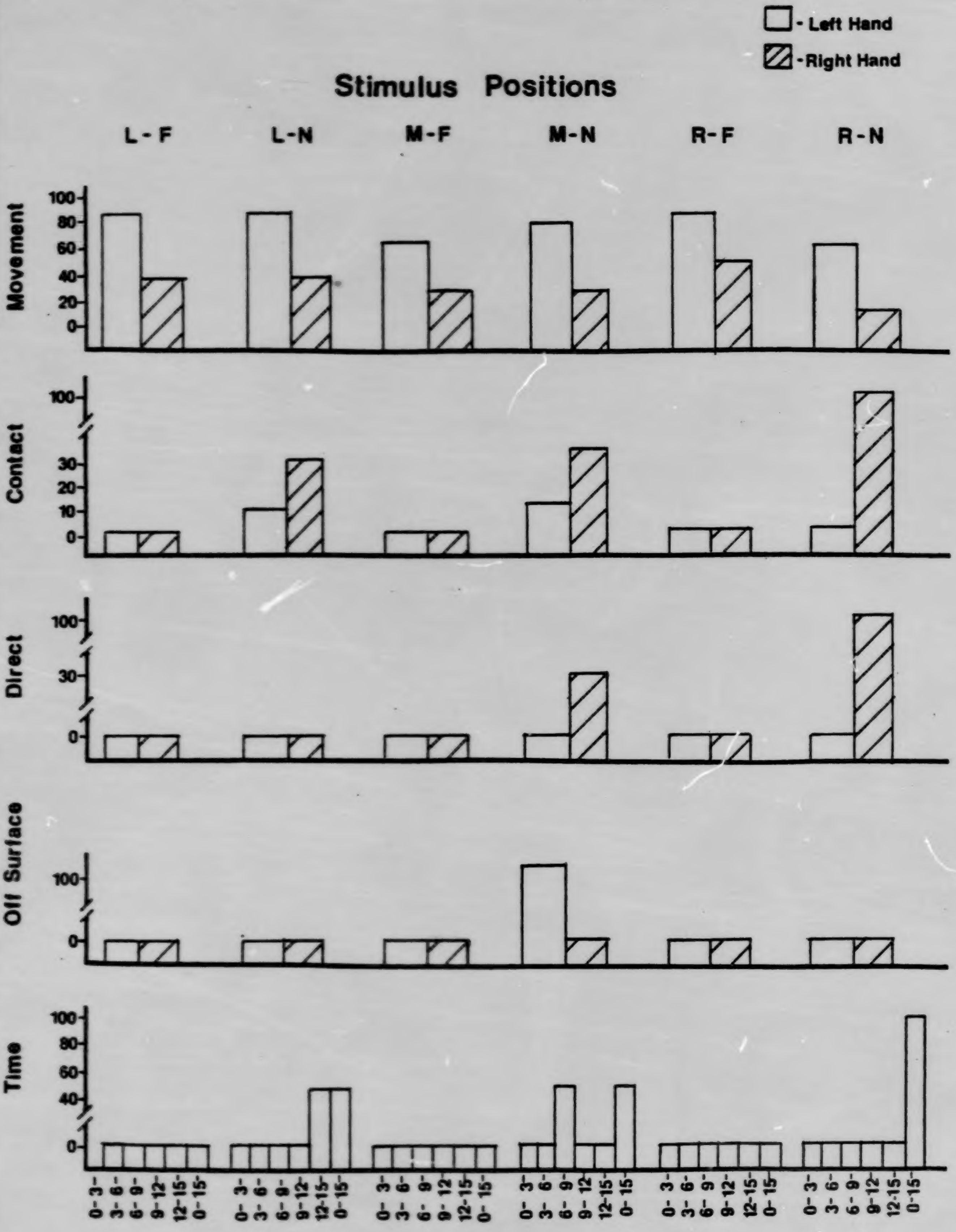

Figure 2' Reach Performance of Subject 2 in Sidelying positions. When the toy was at eye level at the near distance, Matthew moved his right UE only 8% of the time, but was successful at contacting the toy 100% of the time. That movement was also direct 100% of the time. His right UE movement was also direct when the toy was in the mid near position (33% of the time). Otherwise, Matthew's movement was generally indirect. When Matthew contacted the toy in the mid near position with his left UE, his arm/hand always remained off the testing surface and it took him 6-9 seconds 50% of the time to make contact. Other contacts were made with his UE's touching the testing surface during the approach movement. It generally took Matthew 12-15 seconds or over 15 seconds before his movement resulted in contact with the toy.

Sitting position. In the sitting positon (Figure 3), Matthew moved both upper extremities (UE) 50% to 75% of the time in mid far, mid near, right far, and right near stimulus positions and 50% of the time he moved the left UE in the left near position. Movement in the left far stimulus position was less than 33% with both hands. Movement resulted in contact more frequently when the toy was placed at the left and mid near stimulus positions. He contacted 100% of the time with the left arm/hand when the toy was in left near, 57% with the left, and 71% with the right when the toy was in the mid near position. In comparison, he contacted 0% with the left and 20% with the right when the toy was in the right near stimulus position. Matthew's movement were also more direct in the left and mid near stimulus positions (e.g., 100% direct with the left in left near, 29% direct with the left, and 43% with the right in mid near). When the stimulus position was right far, Matthew was direct in his movement with the right

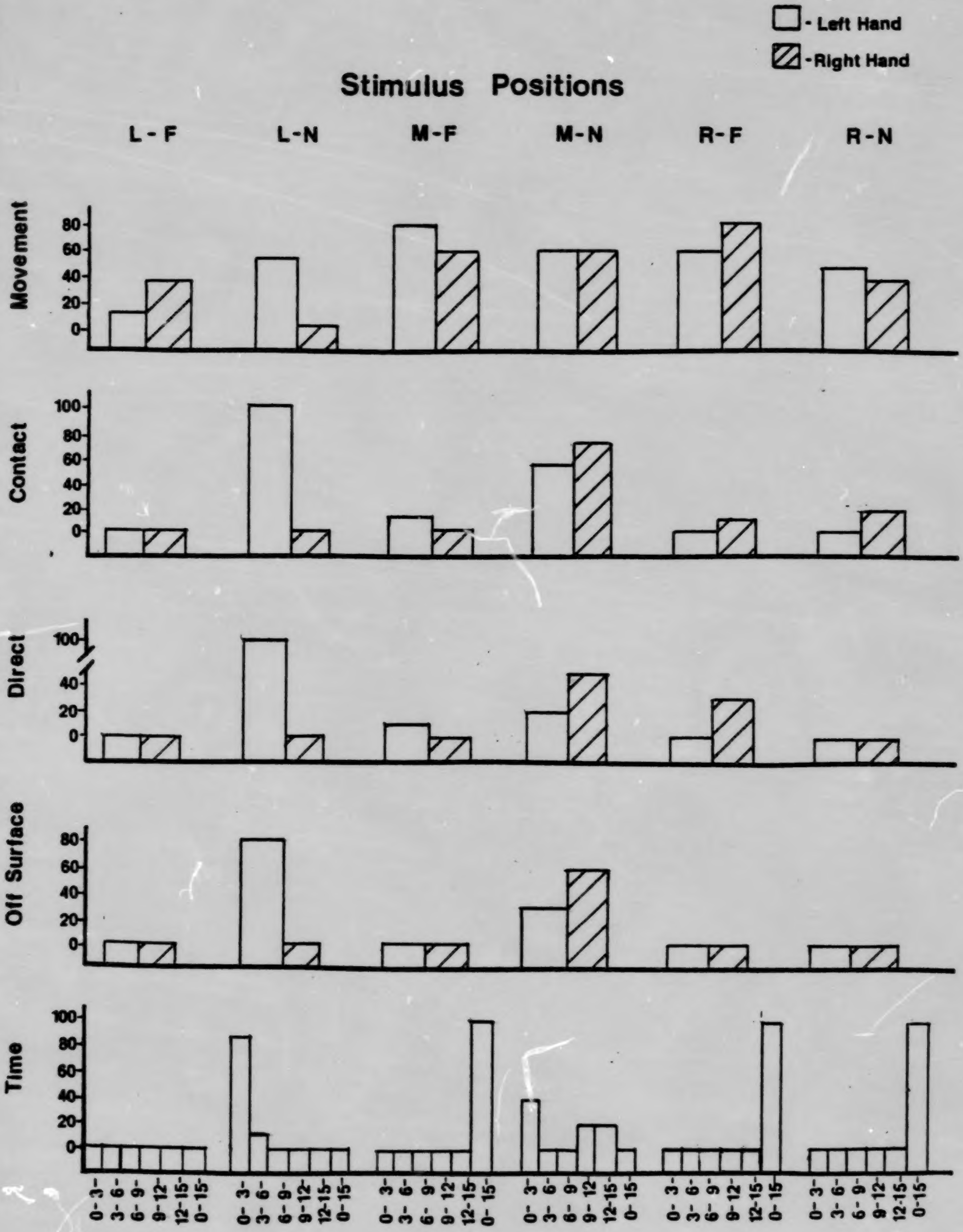

Figure 3: Reach Performance of Subject 2 in Sitting

UE approximately 37% of the time. Contact with the stimulus was made with his arm/hand on the testing surface except when the object was in the left and mid near stimulus positions. For example, Matthew's left UE was off the surface 83% of the time when the toy was in the left near position. Also, in the left and mid near stimulus positions, it took Matthew less time to contact the stimulus object. In the left near position, he contacted the toy 44% of the time in 3 seconds or less, 22% of the time in either 9-12 or 12-15 seconds, and 11% of the time in 15 seconds. Contact in all other stimulus positions took Matthew over 15 seconds.

Subject 3 (Margie)

Supine position. Figure 4 represents the reach responses of Subject 3 in the supine position. In this position, Margie consistently moved both upper extremities (UE) when presented with objects at every stimulus position. She moved her left UE more often (83% to 100% of the time) than the right (50% to 83% of the time). Left UE movement resulted in contact with the toy in every stimulus position with higher percentages at the near distances. For example, she touched the toy 67% to 83% of the time when it was in the near stimulus positions and 17% to 45% of the time when it was in the far positions. Margie was unable to touch the toy in any stimulus position with her right hand and none of her upper extremity movements were direct in nature. When the toy was in the right far position, Margie touched the toy in the shortest amount of time; within 3 seconds 100% of the time. She also had a high percentage of contacts in the 0-3 second time block (approximately 60% of the time) when the toy was placed in the left near and mid far stimulus positions. It took her 12-15 seconds 67% of the time to contact the toy in the left far stimulus position.

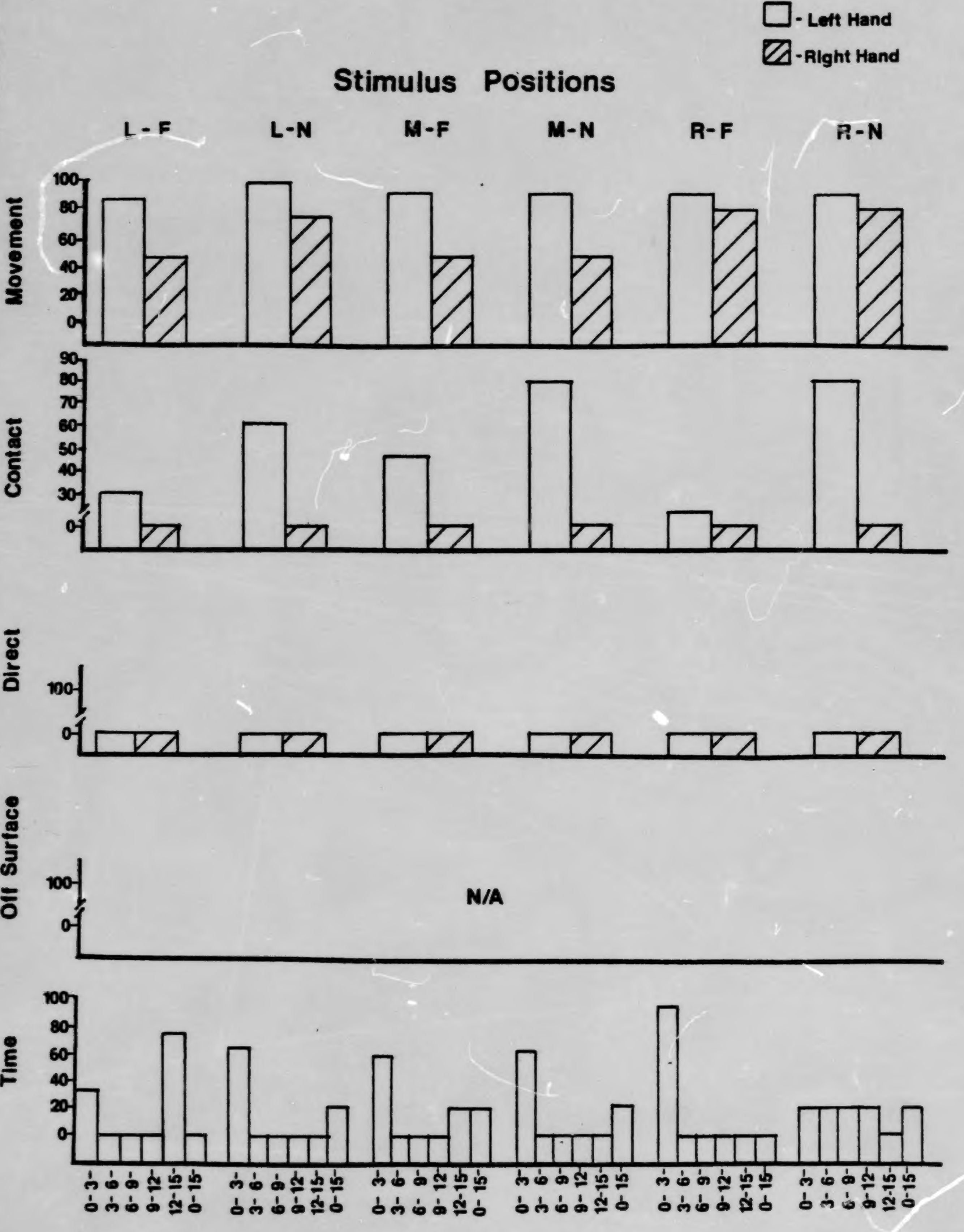

Figure 4: Reach Performance of Subject 3 in Supine

Sitting position. In sitting, Figure 5, Margie consistently moved both upper extremities in all stimulus positions with higher percentages (92%-100%) in the left and right, far and near positions. In mid near, she moved her right UE 75% of the time, her left UE 100% of the time and in the mid far position she moved her right UE 92% of the time and her left 100% of the time. Her right arm movement resulted in contact with the toy 42% of the time only in the right near position. Otherwise, she touched the toy with her left hand in all positions, except right far, with higher percentages when the toy was placed in the left near and mid near positions (approximately 83% of the time). Her right UE movements appeared direct in nature, 17% of the time in one stimulus position (right near). In other stimulus positions she exhibited indirect movement bilaterally. When Margie contacted the toy in the right near position, her left and right hand remained off the testing surface 80% of the time. Her left hand remained off the surface during the approach movement 29% to 80% of the time in the left and mid far positions and in the mid near position. Margie generally made contact faster in the right and mid near stimulus position. Otherwise, the amount of time it took her to touch the toy in the other stimulus positions is fairly evenly distributed across all time blocks.

Subject 4 (Daniel)

Supine position. Figure 6 represents the reach response of Subject 4 in the supine position. Daniel moved both upper extremities 67% to 100% of the time across all stimulus positions with a slightly higher percentage of right UE movement. Daniel had more success at touching the object when

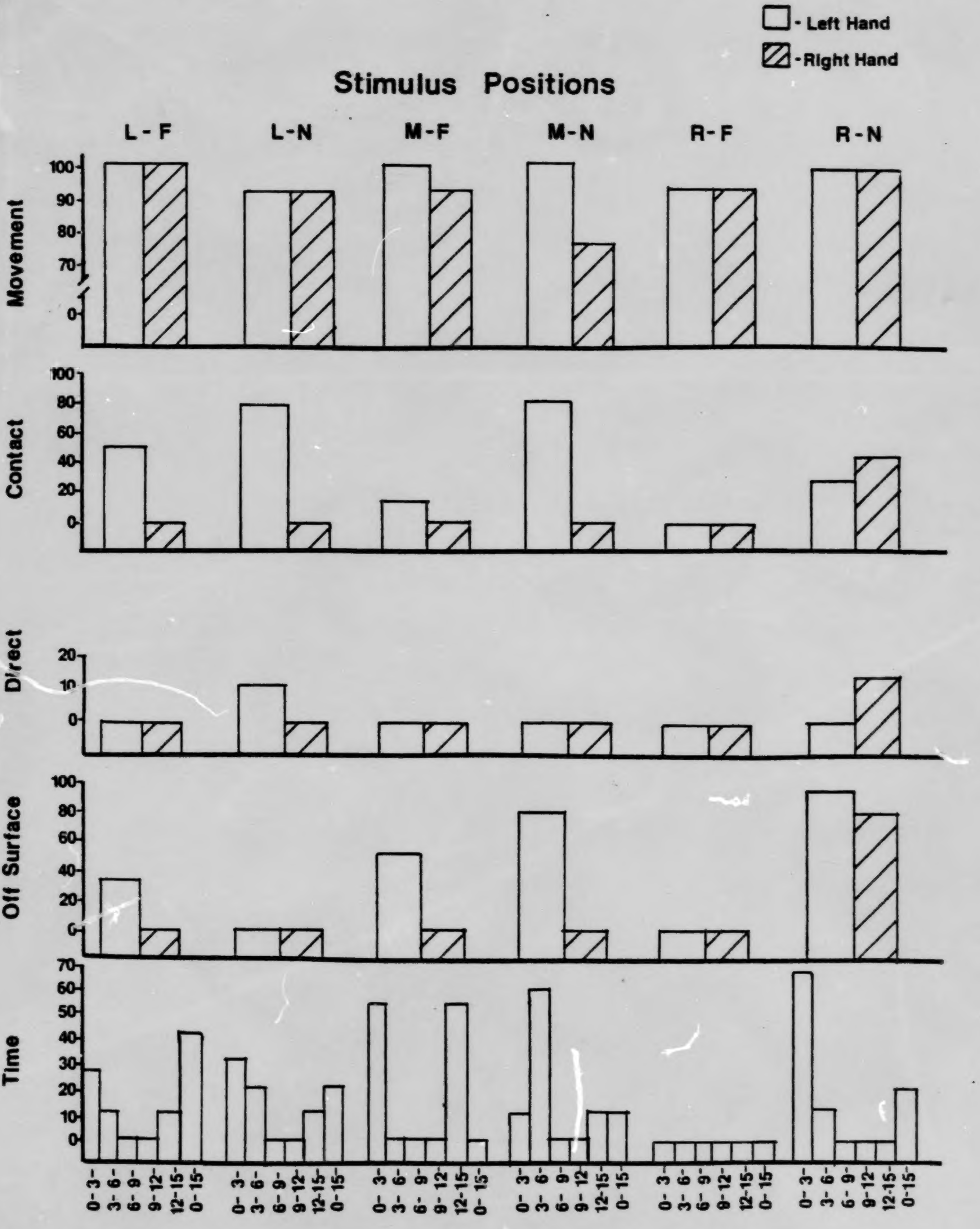

Figure 5: Reach Performance of Subject 3 in Sitting

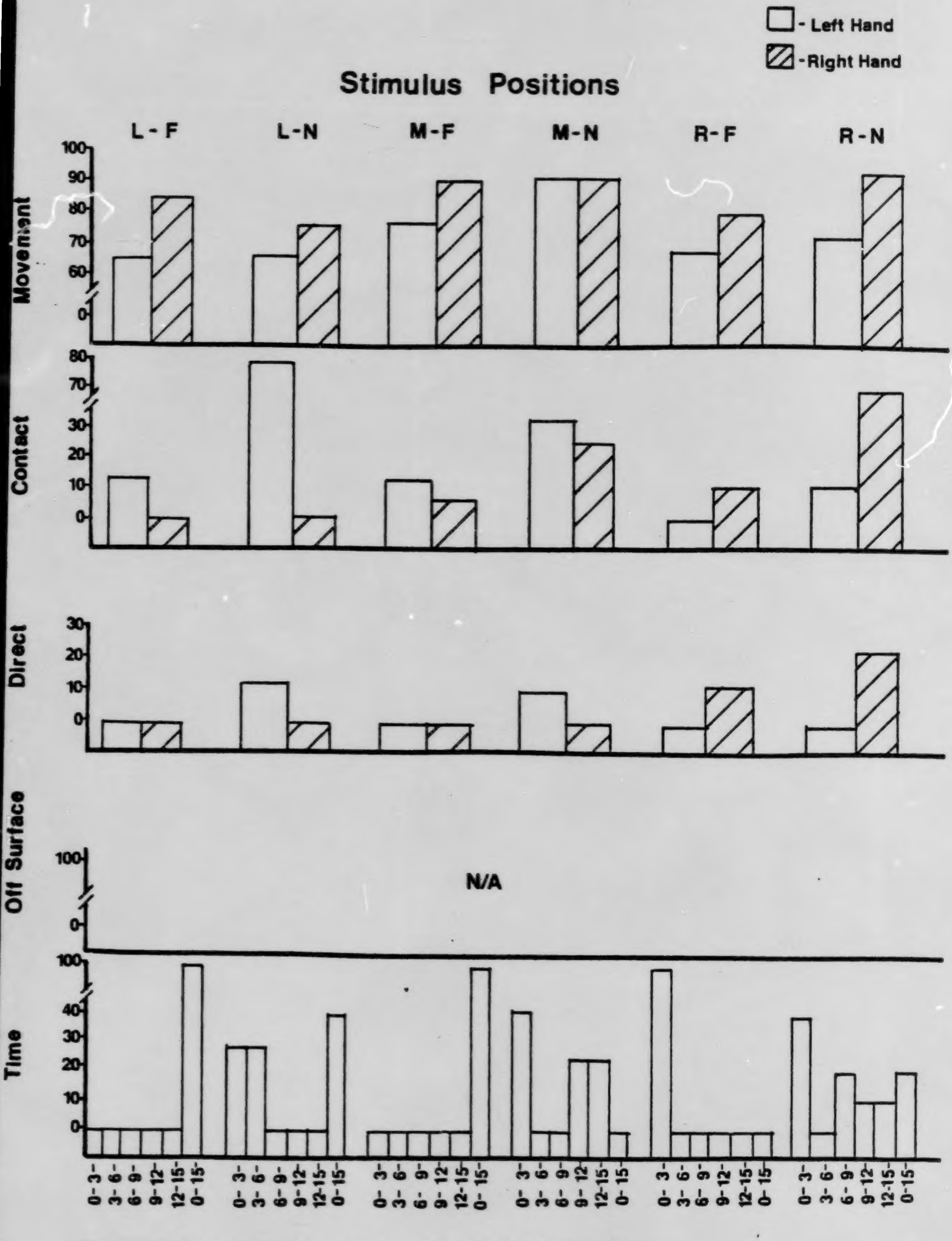

Figure 6: Reach Performance of Subject 4 in Supine

it was at the near distances, this typically was accomplished with the hands nearest the object. For example, the left hand touched left near 87% of the time and the right hand touched right near 75% of the time. It was more difficult for Daniel to contact the toy when it was at mid positions, but he was successful 36% of the time with his left and 27% of the time with his right. Very few of Daniel's movements were direct in nature. The highest percentage of movements were left handed. When the toy was in left near position, 12.5% of the time and right handed when it was in right near position, 25% of the time. It took Daniel over 15 seconds to contact the toy in the far distances (100% of the time in left and mid far), except for right far in which he contacted the toy 100% of the time in less than three seconds. The amount of time it took him to touch the toys in the near stimulus positions was farily evenly distributed across time blocks.

Sitting position. Figure 7 shows how Daniel exhibited a slightly higher percentage of movement with his right UE in all stimulus positions, except the right far, when in a sitting position. His movement result in contact with the stimulus object more often with the left hand (40%-60% of the time) in the left and mid far and near positions. The left hand did not touch any toy when the toy was placed in the right stimulus positions. Contact with the right hand across stimulus positions ranged from 0% to 40%. Daniel's UE movements were rarely direct in nature, but were more direct in the mid near stimulus positions (30% of the time with the left and 10% of the time with the right). Both Daniel's UE were off the testing surface during the approach movements in the mid far and near distances (100% of the time). When the left hand touched the toy in the left stimulus position, it was off the surface 100% of the time. When the

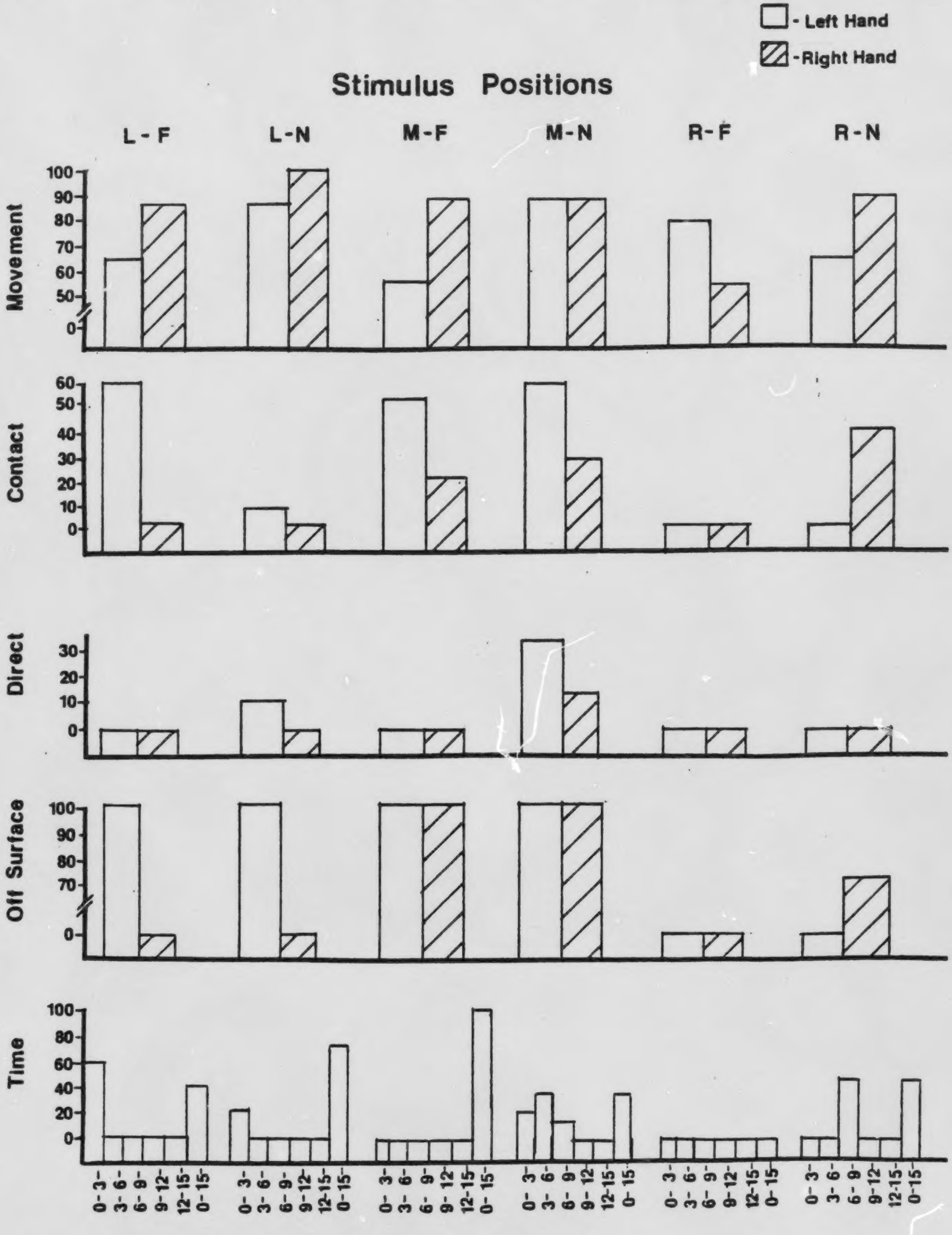

Figure 7: Reach Performance of Subject 4 in Sitting.

right hand contacted the stimulus object in right near, it was off the surface 75% of the time. In the left near and mid far stimulus positions, Daniel took over 15 seconds to contact the stimulus object. In other stimulus positions, the time it took Daniel to touch the toy was evenly distributed across all time blocks.

Subject 5 (Tony)

Standing position. Figure 8 represents the reach response of Subject 5 in the standing position. Tony exhibited a high percentage of upper extremity movement in all stimulus positions with higher percentages of the arm/hand closest to the stimulus object. He contacted the toy 100% of the time in all stimulus positions except right near, which as 83% of the time. Again, contact was made by the hand closest to the stimulus object. He used his left hand exclusively to contact the toy when it was placed in the mid positions. For example, Tony contacted the toy with the left hand when the toy was at the left and mid far and mid near stimulus positions and with the right when it was in the right far and right near stimulus positions. Tony's upper extremity movement was always indirect in nature. When the toys were placed in the left and right near stimulus positions, Tony's UE was off the testing surface during the approach movement to the toy more frequently then not. The left was off 83% of the time in left near position and the left was off 100% of the time in right near position. Tony was consistent in contacting the toy in less than three seconds across all stimulus positions the majority of the time.

Discussion

Overall, this assessment proved to be reliable in observing reach behaviors of handicapped and nonhandicapped children. The lowest total

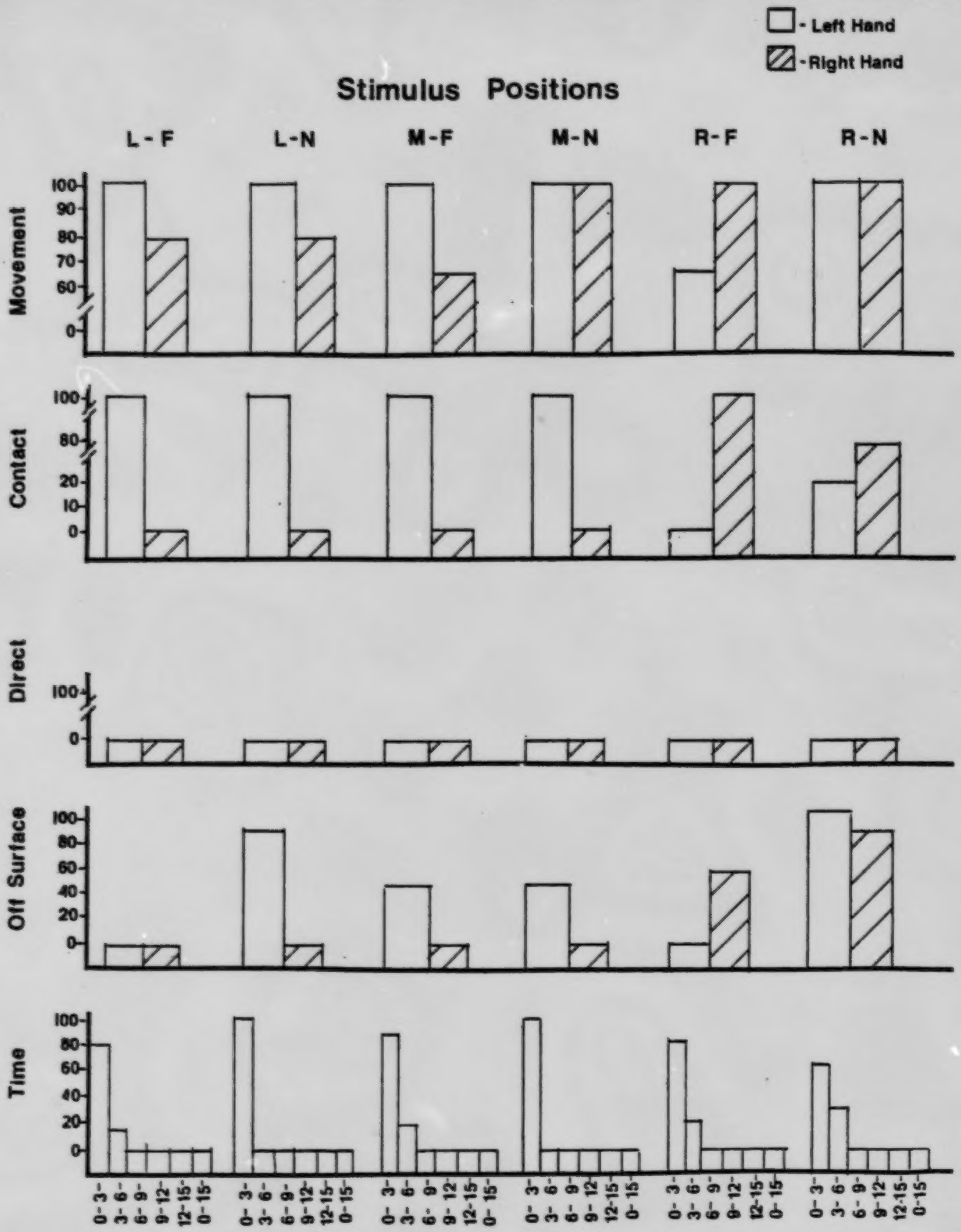

Figure 8: Reach Performance of Subject 5 in Standing

average reliability across all descriptors and stimulus positions for both the right and left hands of all children tested was 91%. The descriptor with the highest reliability across all stimulus positions in all children, but one, was the time or duration of the reach response. The lowest average time reliability across stimulus positions was 97%.

The On/Off surface descriptor was more difficult to observe reliably. The average reliability of On/Off across all stimulus positions ranged from 56% to 96% across the children tested. However, On/Off could only be checked when the child's movement resulted in contact with the stimulus object. Since the frequency with which contact occurred was rather low, the percentage data figured on On/Off in one stimulus position misrepresented the stated average reliability of the descriptor. In some cases, the total trials were often as low as one or two.

No Movement mean reliability in three out of eight reliability tables was below 88% due, again, to the low occurrence of this descriptor.

The remaining descriptors (movement with contact being Direct/Indirect, and movement without contact being Direct/Indirect) had average reliabilities across all stimulus positions ranging from 72.5% to 99%.

Results from Performance Data

The skill data produced from this assessment, as shown in Figures 1 through 8, clearly indicated that this measurement procedure provides a tool that is sensitive to subtle changes in performances, provides operationally defined behaviors, and provides a system for quantifying reach behaviors. From the graphed skill data, the examiner can easily determine a number of factors important to a child's educational programming for fine motor skills:

the best body position, the arm and hand used most efficiently, the optimum distance for the object, and the optimum location for the object.

As compared to the information received from using the currently available assessments, the present assessment procedure provides many more components to observe and gives the examiner a more complete picture of the child's abilities. Frequent assessment using these procedures would identify small gains in a child's reaching abilities (i.e. a child progressing from reaching and contacting only objects in the right stimulus position with the right hand, to reaching and crossing the midline by contacting objects in the left stimulus position with the right hand, etc.).

Problems with Testing Procedures

Some problems in the testing procedures developed as more children with different handicapping conditions were assessed.

The near stimulus positions, length of the child's arm, were found to be too close to the child's body. The right and left near positions were often next to the child's elbow in a sitting and standing psoition. A near distance approximately three-fourths of the child's arm length may be more appropriate.

With some children, the limited size of the stimulus object eliminated toys that the children would most likely respond to. Favorite toys, such as the Fischer Price "See and Say" which have great auditory and visual stimulus characteristics, were too large to use. Even with frequent changing of stimulus toys it was felt that many times, the child did not display his best reaching skills.

Implications and Recommendations for Research

This assessment procedure could be used by classroom teachers to quantifiably measure a child's reaching skills. They could thereby determine the effectiveness of their teaching strategies and evaluate the curriculum content. A teacher may find this assessment more useable if there were fewer trials, or if the entire assessment was done over several days (e.g., in three days give one trial in each stimulus position per day). This would take approximately 10 minutes per day. In order to make the assessment more attractive to a classroom teacher, assessments of grasp, release, and midline skills should be incorporated into one assessment procedure.

The prone position should be investigated to determine if it is a suitable position for assessing a child's reaching abilities. The reach of a child in prone could be included in assessments measuring belly crawling or creeping for an object.

Further longitudinal research using these assessment procedures with both handicapped and nonhandicapped children is needed to determine if this assessment will track the development of reach over time. Tracking nonhandicapped children's abilities to reach from birth through 4 or 5 months using this assessment would give a more complete systematic sequence of the development of the reach behavior. These data would provide information about the rate of acquisition and how "reach" skill acquisition affects grasp, release, and midline skills. Data collection on both handicapped and nonhandicapped populations over an extended period of time, utilizing the measurement procedures developed for reaching behavior, would yield necessary information on similarities and/or differences between the populations in the development of this basic motor behavior.

APPENDIX A

Table 9

Performance Data for Subject 1 in the Supine Position

		Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
		L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials		12/12[2]	12/12	12/12	12/12	11/12	11/12	12/12	12/12	12/12	12/12	12/12	12/12
		100[3]	100	100	100	92	92	100	100	100	100	100	100
Contact: % of movement		1/12	0/12	8/12	0/12	0/11	0/11	0/12	6/12	0/12	0/12	0/12	10/12
		8	0	67	0	0	0	0	50	0	0	0	83
Direct: % of movement		0/12	0/12	0/12	0/12	0/11	0/11	0/12	0/12	0/12	0/12	0/12	0/12
		0	0	0	0	0	0	0	0	0	0	0	0
Off: % of contact		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Time: % of contact	0-3	0/1		0/8		0/0		0/6		0/0		1/10	
		0		0		0		0		0		10	
	3-6	0/1		1/8		0/0		0/6		0/0		0/10	
		0		12.5		0		0		0		0	
	6-9	0/1		0/8		0/0		0/6		0/0		2/10	
		0		0		0		0		0		20	
	9-12	0/1		0/8		0/0		0/6		0/0		2/10	
		0		0		0		0		0		20	
	12-15	0/1		2/8		0/0		4/6		0/0		0/0	
		0		25		0		67		0		0	
	over 15	1/1		5/8		0/0		2/6		0/0		5/10	
		100		62.5		0		33		0		50	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 10

Performance Data for Subject 2 in the Sidelying Position

		Stomach Far		Stomach Near		Mid Far		Mid Near		Eyes Far		Eyes Near	
		L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials		10/12[2]	4/12	10/12	4/12	8/12	3/12	9/12	3/12	10/12	5/12	7/12	1/12
		83[3]	33	83	33	66	25	75	25	83	42	58	8
Contact: % of movement		0/10	0/4	1/10	1/4	0/8	0/3	1/9	1/3	0/10	0/5	0/7	1/1
		0	0	10	25	0	0	11	33	0	0	0	100
Direct: % of movement		0/10	0/4	0/10	0/4	0/8	0/3	0/9	1/3	0/10	0/5	0/7	1/1
		0	0	0	0	0	0	0	33	0	0	0	100
Off: % of contact		0/0	0/0	0/1	0/1	0/0	0/0	1/1	0/1	0/0	0/0	0/0	0/1
		0	0	0	0	0	0	100	0	0	0	0	0
Time: % of contact	0-3	0/0		0/2		0/0		0/2		0/0		0/1	
		0		0		0		0		0		0	
	3-6	0/0		0/2		0/0		0/2		0/0		0/1	
		0		0		0		0		0		0	
	6-9	0/0		0/2		0/0		1/2		0/0		0/1	
		0		0		0		50		0		0	
	9-12	0/0		0/2		0/0		0/2		0/0		0/1	
		0		0		0		0		0		0	
	12-15	0/0		1/2		0/0		0/2		0/0		0/1	
		0		50		0		0		0		0	
	over 15	0/0		1/2		0/0		1/2		0/0		1/1	
		0		50		0		50		0		0	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 11

Performance Data for Subject 2
in the Sitting Position

	Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
	L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials	2[2]/12	4/12	6/12	0/12	9/12	7/12	7/12	7/12	7/12	8/12	6/12	5/12
	17[3]	33	50	0	75	58	58	58	58	67	50	42
Contact: % of movement	0/2	0/4	6/6	0/0	1/9	0/7	4/7	5/7	0/7	1/8	0/6	1/5
	0	0	100	0	11	0	57	71	0	12.5	0	20
Direct: % of movement	0/2	0/4	6/6	0/0	1/9	0/7	2/7	3/7	0/7	3/8	0/6	0/5
	0	0	100	0	11	0	29	43	0	37.5	0	0
Off: % of contact	0/0	0/0	5/6	0/0	0/1	0/0	1/4	3/5	0/0	0/1	0/0	0/1
	0	0	83	0	0	0	25	60	0	0	0	0
Time: % of Contact												
0-3	0/0		5/6		0/1		4/9		0/1		0/1	
	0		83		0		44		0		0	
3-6	0/0		1/6		0/1		0/9		0/1		0/1	
	0		17		0		0		0		0	
6-9	0/0		0/6		0/1		0/9		0/1		0/1	
	0		0		0		0		0		0	
9-12	0/0		0/6		0/1		2/9		0/1		0/1	
	0		0		0		22		0		0	
12-15	0/0		0/6		0/1		2/9		0/1		0/1	
	0		0		0		22		0		0	
over 15	0/0		0/6		1/1		1/9		1/1		1/1	
	0		0		100		11		100		100	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 12

Performance Data for Subject 3
in the Supine Position

	Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
	L[1]	R	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials	10/12[2] 83[3]	7/12 58	12/12 100	8/12 67	11/12 92	6/12 50	12/12 100	7/12 58	12/12 100	10/12 83	12/12 100	10/12 83
Contact: % of movement	3/10 30	0/7 0	8/12 67	0/8 0	5/11 45	0/6 0	10/12 83	0/7 0	2/12 17	0/10 0	10/12 83	0/10 0
Direct: % of movement	0/10 0	0/7 0	0/12 0	0/8 0	0/11 0	0/6 0	0/12 0	0/7 0	0/12 0	0/10 0	0/12 0	0/10 0
Off: % of contact	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Time: % of contact												
0-3	1/3 33		5/5 62.5		3/5 60		6/10 60		2/2 100		2/10 20	
3-6	0/3 0		1/8 12.5		0/5 0		0/10 0		0/2 0		2/10 20	
6-9	0/3 0		0/8 0		0/5 0		1/10 10		0/2 0		2/10 20	
9-12	0/3 0		0/8 0		0/5 0		0/10 0		0/2 0		2/10 20	
12-15	2/3 67		0/8 0		1/5 20		0/10 0		0/2 0		0/10 0	
over 15	0/3 0		2/8 25		1/5 20		3/10 30		0/2 0		2/10 20	

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[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 13

Performance Data for Subject 3 in the Sitting Position

		Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
		L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials		12/12[2]	12/12	11/12	11/12	12/12	11/12	12/12	9/12	11/12	11/12	12/12	12/12
		100[3]	100	92	92	100	92	100	75	92	92	100	100
Contact: % of movement		7/12	0/12	9/11	0/11	2/12	0/11	10/12	0/9	0/11	0/11	4/12	5/12
		58	0	82	0	17	0	83	0	0	0	33	42
Direct: % of movement		0/12	0/12	1/11	0/11	0/2	0/11	0/12	0/9	0/11	0/11	0/12	2/12
		0	0	9	0	0	0	0	0	0	0	0	0
Off: % of contact		2/7	0/0	0/9	0/0	1/2	0/0	8/10	0/0	0/0	0/0	4/4	4/5
		29	0	0	0	50	0	80	0	0	0	100	80
Time: % of contact	0-3	2/7		3/9		1/2		1/10		0/0		6/9	
		29		33		50		10		0		67	
	3-6	1/7		2/9		0/2		6/10		0/0		1/9	
		14		22		0		60		0		11	
	6-9	0/7		0/9		0/2		0/10		0/0		0/9	
		0		0		0		0		0		0	
	9-12	0/7		0/9		0/0		1/10		0/0		0/9	
		0		0		0		10		0		0	
	12-15	1/7		1/9		1/2		1/10		0/0		0/9	
		14		11		50		10		0		0	
	over 15	3/7		3/9		0/2		1/10		0/0		2/9	
		43		33		0		10		0		22	

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[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 14

Performance Data for Subject 4 in the Supine Position

		Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
		L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials		8[2]/12	10/12	8/12	9/12	9/12	11/12	11/12	11/12	8/12	10/12	9/12	12/12
		67[3]	83	67	75	75	92	92	92	67	83	75	100
Contact: % of movement		1/8	0/10	7/8	0/9	1/9	1/11	4/11	3/11	0/8	1/10	1/9	9/12
		12.5	0	87.5	0	11	9	36	27	0	10	11	75
Direct: % of movement		0/8	0/10	1/8	0/9	0/9	0/11	1/11	0/11	0/8	1/10	0/9	3/12
		0	0	12.5	0	0	0	9	0	0	10	0	25
Off: % of contact		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Time: % of contact	0-3	0/1		2/7		0/2		3/7		1/1		4/10	
		0		29		0		43		100		40	
	3-6	0/1		2/7		0/2		0/7		0/1		0/10	
		0		29		0		0		0		0	
	6-9	0/1		0/7		0/2		0/7		0/1		2/10	
		0		0		0		0		0		20	
	9-12	0/1		0/7		0/2		2/7		0/1		1/10	
		0		0		0		29		0		10	
	12-15	0/1		0/7		0/2		2/7		0/1		1/10	
		0		0		0		29		0		10	
	over 15	1/1		3/7		2/2		0/7		0/1		2/10	
		100		43		100		0		0		20	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 15

Performance Data for Subject 4
in the Sitting Position

		Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
		L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials		8/12[2]	10/12	10/12	12/12	7/12	10/12	10/12	10/12	9/12	6/12	8/12	10/12
		67[3]	83	83	100	58	83	83	83	75	50	67	83
Contact: % of movement		5/8	0/10	4/10	0/12	4/7	2/10	6/10	3/10	0/12	0/6	0/8	4/10
		62.5	0	10	0	57	20	60	30	0	0	0	40
Direct: % of movement		0/8	0/10	1/10	0/12	0/7	0/10	3/10	1/10	0/12	0/6	0/8	0/10
		0	0	10	0	0	0	30	10	0	0	0	0
Off: % of contact		5/5	0/0	4/4	0/0	4/4	2/2	6/6	3/3	0/0	0/0	0/0	3/4
		100	0	100	0	100	100	100	100	0	0	0	75
Time: % of contact	0-3	3/5		1/4		0/6		2/9		0/0		0/4	
		60		25		0		22		0		0	
	3-6	0/5		0/4		0/6		3/9		0/0		0/4	
		0		0		0		33		0		0	
	6-9	0/5		0/4		0/6		1/9		0/0		2/4	
		0		0		0		11		0		50	
	9-12	0/5		0/4		0/6		0/9		0/0		0/4	
		0		0		0		0		0		0	
	12-15	0/5		0/4		0/6		0/9		0/0		0/4	
		0		0		0		0		0		0	
	over 15	2/5		3/4		6/6		3/9		0/0		2/4	
		40		75		100		33		0		50	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

Table 16

Performance Data for Subject 5
in the Standing Position

	Left Far		Left Near		Mid Far		Mid Near		Right Far		Right Near	
	L	R[1]	L	R	L	R	L	R	L	R	L	R
Movement: % of total trials	12[2]/12 100[3]	10/12 83	12/12 100	10/12 83	12/12 100	8/12 67	12/12 100	12/12 100	8/12 67	12/12 100	12/12 100	12/12 100
Contact: % of movement	12/12 100	0/10 0	12/12 100	0/10 0	12/12 100	0/8 0	12/12 100	0/12 0	0/8 0	12/12 100	2/12 17	10/12 83
Direct: % of movement	0/12 0	0/10 0	0/12 0	0/10 0	0/12 0	0/8 0	0/12 0	0/12 0	0/8 0	0/12 0	0/12 0	0/12 0
Off: % of contact	0/12 0	0/0 0	10/12 83	0/0 0	4/12 33	0/0 0	4/12 33	0/0 0	0/0 0	6/12 50	2/2 100	8/10 80
Time: % of contact 0-3	10/12 83		12/12 100		10/12 83		12/12 100		10/12 83		8/12 67	
3-6	2/12 17		0/12 0		2/12 17		0/12 0		2/12 17		4/12 33	
6-9	0/12 0		0/12 0		0/12 0		0/12 0		0/12 0		0/12 0	
9-12	0/12 0		0/12 0		0/12 0		0/12 0		0/12 0		0/12 0	
12-15	0/12 0		0/12 0		0/12 0		0/12 0		0/12 0		0/12 0	
over 15	0/12 0		0/12 0		0/12 0		0/12 0		0/12 0		0/12 0	

[1] L indicates left arm; R indicates right arm.

[2] Proportion of the number of occurrences over the number of possible occurrences.

[3] This proportion expressed as a percentage.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE GRASP BEHAVIOR AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped and Five Handicapped Preschoolers[1]

by

Teresa W. Neese

and

Marilyn Mulligan

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[1] The procedures and data reported in this study were taken from a Master's thesis submitted to the Department of Special Education at the University of Kansas, July, 1980.

Overview of the Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages FM(G) 1 to FM(G) 21 of Volume I, *Assessment Procedures for Selected Developmental Milestones*. Procedures were developed to measure both a voluntary and reflexive grasp. They were demonstrated on children in three different body positions: sitting and supported sitting, right and left sidelying, and standing. Measures were taken on the topography of the grasp behavior across four different materials in each measurement session.

The behaviors measured in the topography of the grasp response were: use of the right or left hand, digits involved in the grasp, and the portion of the hand (palm or tips of fingers) touching the object at the moment of grasp. These responses were observed across four different stimulus items for each sesion. The materials included a ring, cylinder, cube, and pellet with specific dimensions delineated. A session included twelve trials, three trials per stimulus item, for each child in one body position. Each child was evaluated in one or two of his/her most functional positions across four observation sessions.

Procedures developed for assessing a voluntary grasp (Method A) were used if the child retained objects independently or grasped some of the objects but only touched others. To assess grasp behavior, the experimenter placed one stimulus object on the presentation surface near the child's hand. If the child did not grasp the object, procedures were followed in order to draw the child's attention to the object by repeating auditory, visual, or tactile cues. If the child grasped the object, the topography of the grasp response at the moment the stimulus object was removed from the presentation surface was recorded in the appropriate row on the data sheet (Figure 1, page FM(G) 5 of Volume I). Only the fingers touching the object were scored. If any part of the palm was touching the object, the grasp was recorded as a palm grasp.

Procedures developed for assessing a reflexive grasp (Method B) were used if the child touched but did not hold or retain any of the objects, or did not touch any of the objects. Three different types of reflexive grasp were tested: inside (radial), outside (ulnar), and middle (palmar) instinctive grasps. For all three grasps, the stimulus item was moved in a distal direction down the child's arm. Light pressure was applied continuously as the item was moved into the child's hand. The responses of the child were recorded as inside, outside, or middle palm grasp, depending on where the stimulation was applied on the child's arm. Digits involved in the grasp were also recorded.

Subject

This study included both preschool multiply handicapped children and one nonhandicapped infant. The five handicapped subjects were selected from the Preschool for the Severely Multiply Handicapped at the University of Kansas Medical Center. Selection criteria included: (a) all children functioning at less than the 12 month level of normal development for fine motor skills (b) subjective judgment by the first author of the presence of manipulation skills at seemingly different levels of functioning for each child, (c) one subject's absence of voluntary grasp and subjective presence of reflexive grasp activity, and (d) cooperation and support by the preschoolers' families. Below is a brief description of each subject tested in this study.

Subject 1. Clay was a normally developing 10 months old male. He was only tested in the sitting position, his optimal position at this time.

Subject 2. Brent was a 3 year old male with severe developmental delay and hypotonic muscle tone. According to the motor development section of the Callier-Azusa Scale (Stillman, 1978), Brent was functioning at the 6 month level. He had voluntary reach and grasp and was usually optimally positioned in the classroom in either the sitting position of left or right sidelying positions.

Subject 3. Judy was a 4 year old ambulatory female with spastic quadriparesis, a seizure disorder, microcephaly, and severe developmental delay. According to the motor development section of the Callier-Azusa, Judy was functioning at the 10 month level. She had voluntary reach and grasp and was optimally positioned in the classroom in either the sitting or the standing positions.

Subject 4. Becky was a 4 year old female with severe developmental delay, hypotonic muscle tone, strabismius and psychomotor retardation. According to the motor development section of the Callier-Azura, Becky was functioning at the 3 month level. She could grasp and release, and was optimally positioned in the sitting position on the floor or in a preschool sized chair.

Subject 5. Nancy was a 3 year old female with Wolf-Hirchhorn Syndrome, grade mal and petit mal seizure disorders, and severe developmental delay. According to the motor section of the Callier-Azusa she was functioning at the 3 month level. She had voluntary grasp and release. Nancy's optimal classroom position was in the "corner" chair or her orthokinetic travel chair.

Subject 6. Mike was a 4 year old male with spastic quadriparesis, a seizure disorder, and severe developmental delay. According to the motor section of the Callier-Azusa, Mike was functioning well below the 6 month level. Mike did not demonstrate voluntary grasp and did not roll or sit independently. His optimal classroom position was supported sitting in a "corner" chair or his orthokinetic travel chair.

Procedures for Obtaining Measures of Reliability

Measures of reliability for all positions (sidelying, sitting, and standing) were taken with the experimenter by either a biased or an unbiased observer. A biased observer was a person who had formal training in areas of observing behavior and recording data and was intimately involved with this Institute research. Only one observer, a Special education teacher, was biased. An unbiased observer was a person without formal training in the above mentioned areas and was not directly involved with the Institute research. The unbiased observers included two occupational therapists, a secretary, and a parent.

The observer sat next to the examiner with a clipboard, data sheet and pencil. During the trials, the observer moved around as needed for a good view of the child's movement. Once the trial began, there was no verbal discussion between the observer and the examiner. When the trial was over, the examiner and the observer independently recorded performances on the data sheet. There was no discussion about what was observed until after the data sheet was completed for each trial or until after the session was completed. During trials when the child was non-compliant or obviously not attending to the stimulus, the examiner discontinued the trial and neither the examiner nor the observer recorded the observations.

The formula used to compute reliability between observers and the examiner for each child in each body position was:

$$\frac{\text{\# of agreements}}{\text{\# of disagreements + agreements}} \quad \times 100$$

For each behavior that had an opportunity to be scored the number of agreements was divided by the number of agreements plus the number of disagreements and multiplied by 100 to obtain the reliability score for each trial. The sum of the reliability scores for each trial in each session were summed and divided by the total number of trials to calculate the overall reliability for each session.

Results

Two types of measures are presented in this chapter, 1) the results of the interobserver reliability for the grasp assessment procedure by individual subjects in each position and 2) the performance data acquired through the use of the procedures. The specific description of mean reliabilities for Method A for Subject 1 through 5 in the sitting, standing, and sidelying positions are presented in Tables 1 through 8. Overall mean reliability measures across the three positions are also presented in Table 9. In addition, the mean reliability scores for Subject 6 utilizing Method B are presented in Tables 10 and 11.

Table 1

Reliability Scores for Subject 1
in the Sitting Position

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	100	100	100	100	91	75	91	82
Ring	100	91	100	100	91	83	83	92
Cube	100	100	100	100	100	83	100	97
Pellet	100	83	91	75	75	83	33	77
Mean Column Reliability	100	93	97	93	89	81	76	87

Table 2

Reliability Scores for Subject 2 in the Sitting Position

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	100	100	100	100	83	83	58	89
Ring	100	100	91	100	100	83	100	96
Cube	100	100	58	66	58	83	50	73
Pellet	100	100	83	75	100	100	83	91
Mean Column Reliability	100	100	83	85	85	87	72	87

Table 3

Reliability Scores for Subject 3
in the Sitting Position

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	100	100	100	83	83	75	83	89
Ring	100	100	100	83	91	75	75	89
Cube	100	100	91	100	58	66	91	86
Pellet	100	91	91	100	100	100	83	95
Mean Column Reliability	100	97	95	91	83	79	83	89

Table 4

Reliability Scores for Subject 4
in the Sitting Position

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved 1	2	3	4	5	Palm/ Tip	
Cylinder	100	100	91	100	100	83	83	93
Ring	100	100	91	100	91	75	83	91
Cube	75	100	83	100	100	83	91	90
Pellet	No Grasp							
Mean Column Reliability	91	100	88	100	97	80	85	91

Table 5

Reliability Scores for Subject 5
in the Sitting Position

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	91	91	91	100	91	33	75	81
Ring	91	75	83	91	91	91	100	88
Cube	91	100	91	100	100	41	91	87
Pellet	No Grasp							
Mean Column Reliability	91	94	88	97	97	55	88	86

Table 6

Reliability Scores For Subject 3 in the Standing Position

Stimulus Materials	Descriptors: Right/ Left	Digits Involved 1	2	3	4	5	Palm/ Tip	Mean Row Reliability
Cylinder	100	100	100	91	75	83	83	90
Ring	91	100	100	100	91	91	91	94
Cube	91	100	100	100	75	33	91	84
Pellet	100	100	100	41	100	91	41	81
Mean Column Reliability	95	100	100	83	85	74	76	87

Table 7

Reliability Scores for Subject 2
in the Right Sidelying Position with the Left Arm on Top

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	100	100	100	91	75	75	83	89
Ring	100	83	91	100	83	83	83	89
Cube	100	100	83	100	66	83	75	86
Pellet	100	100	100	75	91	91	100	93
Mean Column Reliability	100	95	93	91	78	83	85	89

Table 8

Reliability Scores for Subject 2 in the Left Sidelying Position with the Right Arm on Top

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder	100	100	91	100	83	66	83	83
Ring	83	100	91	100	66	41	100	83
Cube	100	100	91	83	83	75	41	81
Pellet	100	100	91	100	100	100	75	95
Mean Column Reliability	95	100	91	95	83	70	74	86

Table 9

Mean Reliability Scores Using Method A for All Subjects in Each Position Assessed

	Position				
Subject	Sitting	Standing	Sidelying		Row Reliability
			Left	Right	
1	87				87
2	87		85	89	87
3	89	87			88
4	91				91
5	86				86
Column Reliability	88	87	85	89	87

Table 10

Reliability Scores for Subject 6
for the Left Hand in the Supported Sitting Position
Testing Palmar Reflexive Grasp with Method B

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder		98	100	100	100	100	100	99
Ring		100	100	100	100	100	100	100
Cube	No Grasp							
Pellet	No Grasp							
Mean Column Reliability		99	100	100	100	100	100	99

Table 11

Reliability Scores for Subject 6
for the Right Hand in the Supported Sitting Position

Testing Palmar Reflexive Grasp with Method B

Stimulus Materials	Descriptors							Mean Row Reliability
	Right/ Left	Digits Involved					Palm/ Tip	
		1	2	3	4	5		
Cylinder		100	100	100	100	100	100	100
Ring		98	100	100	100	100	100	99
Cube		100	100	100	100	100	100	100
Pellet		100	100	100	100	100	100	100
Mean Column Reliability		99	100	100	100	100	100	99

Reliability Measures for the Sitting or Supported Sitting Position-Method A

Summarized below are the reliability results of those subjects assessed in the sitting position or supported sitting position utilizing Method A procedures. Method A was used for those subject who had voluntary grasp for the majority of the stimulus objects presented. Tables 1 through 8 show reliability data by subjects in one position. The reliability of each descriptor; Right/Left, digits 1, 2, 3, 4 or 5 involved, and Palm/Tip are listed for each stimulus material. The Mean Row Reliability shows the reliability measure across all descriptors for each stimulus item. The Mean Column Reliability shows the reliability of a particular descriptor across all four objects. The lower right corner of each table shows the grand mean, the mean of all descriptors across all materials.

Subject 1. Table 1 represents reliability scores for Subject 1 across all materials and descriptors. The range of reliability for descriptors across four objects was 76% to 100%. The range of reliability for descriptors per material was 77% to 97%. The total session reliability was 87%.

Subject 2. Table 2 represents reliability scores for Subject 2 across all materials and descriptors. The range of reliability for descriptors across four objects was 72% to 100%. The range of reliability for descriptors per material was 73% to 96%. The total session reliability was 87%.

Subject 3. Table 3 represents reliability scores for Subject 3 across all materials and descriptors. The range of reliability for descriptors across four objects was 83% to 100%. The range of reliability for descriptors per materials was 86% to 95%. The total session reliability was 89%.

Subject 4. Table 4 represents reliability scores for Subject 4 across all materials (except the pellet) and descriptors. Subject 4 did not grasp or touch the pellet. The range of reliability for descriptors across three objects was 80% to 100%. The range of reliability for descriptors per material was 90% to 93%. The total session reliability was 91%.

Subject 5. Table 5 represents reliability scores for Subject 5 in the sitting position across all materials (except the pellet) and discriptors. Subject 5 did not grasp or touch the pellet. The range of reliability for descriptors across three objects was 55% to 97%. The 55% reliability measure was for the fifth digit. The range of reliability scores for descriptors per material was 81% to 87%. The total session reliability was 86%.

Reliability Measures for the Standing Position-Method A

Summarized below are the reliability results of one handicapped subject assessed in the standing position utilizing the procedures described in Method A.

Subject 3. Table 6 represents reliability scores for Subject 3 across all materials and descriptors. The range of reliability for descriptors across four objects was 74% to 100%. The range of reliability scores for descriptors per material was 81% to 94%. The total session reliability was 87%.

Reliability Measures for the Sidelying Positons-Method A

Summarized below are the reliability results of one handicapped subject assessed in right and left sidelying positions utilizing Method A.

Subject 2. Table 7 represents reliability scores for Subject 2 in the right sidelying position across all materials and descriptors. The range of reliability for descriptors across four objects was 78% to 100%. The range of reliability for descriptors per material was 86% to 93%. The total session reliability was 89%.

Subject 2. Table 8 represents reliability scores for Subject 2 in the left sidelying position across all materials and descriptors. The range of reliability for descriptors across four objects was 70% to 100%. The range of reliability for a descriptor per object was 81% to 95%. The total session reliability was 86%.

Overall Reliability

Summarized in Table 9 is the mean reliability of Method A across the five subjects (one non-handicapped and four handicapped) in the sitting position, across one subject (Subject 3) in the sitting and standing positions, and one subject (Subject 2) in the sitting and sidelying positions. Table 9 also includes the overall assessment reliability across all subjects (one non-handicapped and four handicapped) in all positions utilizing Method A.

Sitting position. The mean reliability across one non-handicapped and four handicapped students was 88%.

Sitting and standing positions. The overall reliability of Subject 3 in these two positions was 88%.

Sitting and Sidelying positions. The overall reliability of Subject 2 in these three positions was 87%.

Overall reliability across positions and subjects. The overall reliability across all subjects (one non-handicapped and four handicapped) in all positions was 87% for Method A.

Reliability Measures for the Supported Sitting Position-Method B

Summarized below are the reliability results of one handicapped subject (Subject 6) assessed in the supported sitting position utilizing Method B. Method B's procedures were for those students who did not demonstrate a voluntary grasp with either hand. Tables 10 and 11 show the reliability results for Subject 6 assessed for plamar reflexive grasp in the supported sitting position. This subject did not respond when radial and ulnar reflexive grasp was tested. Both the left and right hands' results are shown. Tables 10 and 11 are interpreted in the same manner as Tables 1 through 8.

Subject 6. There was 100% agreement between observers that no occurrence of radial or ulnar reflexive grasp was observed during the testing sessions, for either the left or the right hands. The range of reliability for left hand palmar grasp for descriptors across four objects was 99% to 100%. The range of reliability for the left hand for descriptors per material was 99% to 100%. The total session reliability for left hand palmar grasp was 99%. The range of reliability for right hand palmar grasp for descriptors across four objects was 99% to 100%. The range of reliability for right hand palmar grasp for descriptors per material was 99% to 100%. The total session reliability for right hand palmar grasp was 99%.

Performance Results

The performance data reflect the individual skill levels of each subjects tested. The specific performance results or skill data are discussed for Subjects 1 through 5 in each position utlizing Method A procedures. The skill levels are graphically illustrated in Figures 1 through 7 taken from the performance data exhibited in tables 12 through 19. Performance results are also presented for Subject 6, utilizing Method B procedures, with the performance data shown in Table 20.

Performance Results for the Sitting or Supported Sitting Position-Method A

Summarized below are the performance results for those subjects, one nonhandicapped and four handicapped, assessed in the sitting or supported sitting position utilizing Method A procedure. Method A's usage was for those subjects who had voluntary grasp for the majority of the stimulus objects presented.

Performance data is graphically represented in Figures 1 through 8. The vertical axis lists the percentage of descriptor use for each stimulus material. The horizontal axis is divided first into two main sections, performance for the the right and left hands. For each hand the, descriptors of digits 1, 2, 3, 4, and 5, and Tips are presented. The graph illustrates the percentage of descriptor use for each stimulus object for the right and/or left hands. The number in parentheses shows the overall percentage of right or left hand use. The raw data for these figures are presented in Tables 12 through 19 in Appendix A.

Appendix A, tables 12 through 19 show, by subject per position, the percentage of each descriptor's use per object for each hand. Also shown is the actual ratio of descriptor occurrence or the number of occurrences over the number possible occurrences. Each table lists right hand performance raw data, then left hand performance raw data. The individual descriptors of 1, 2, 3, 4, 5, and (T)ips and are presented in the columns for each stimulus material. The top number indicates the actual number of

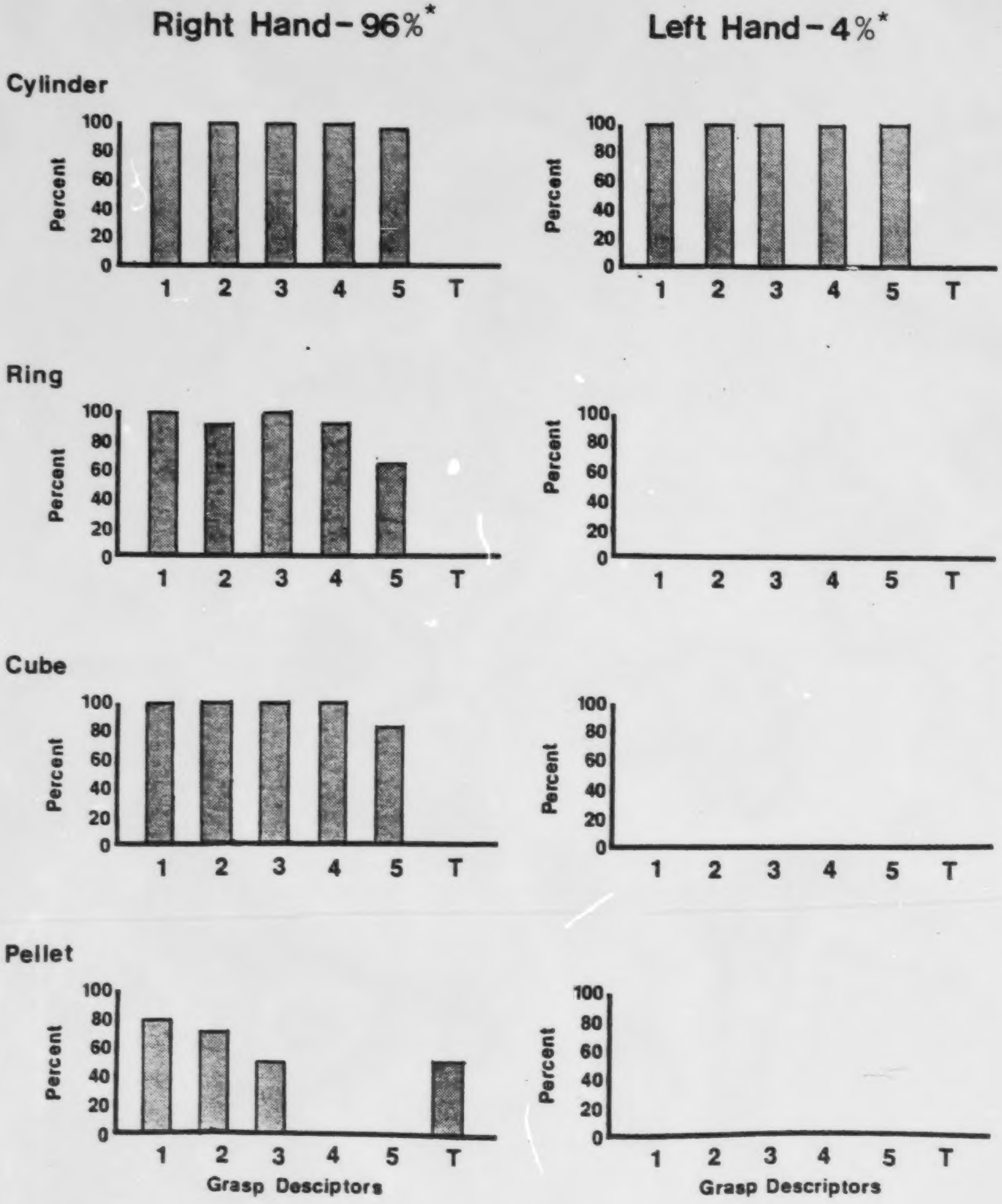

Figure 1: Performance data for Subject 1 in the Sitting Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

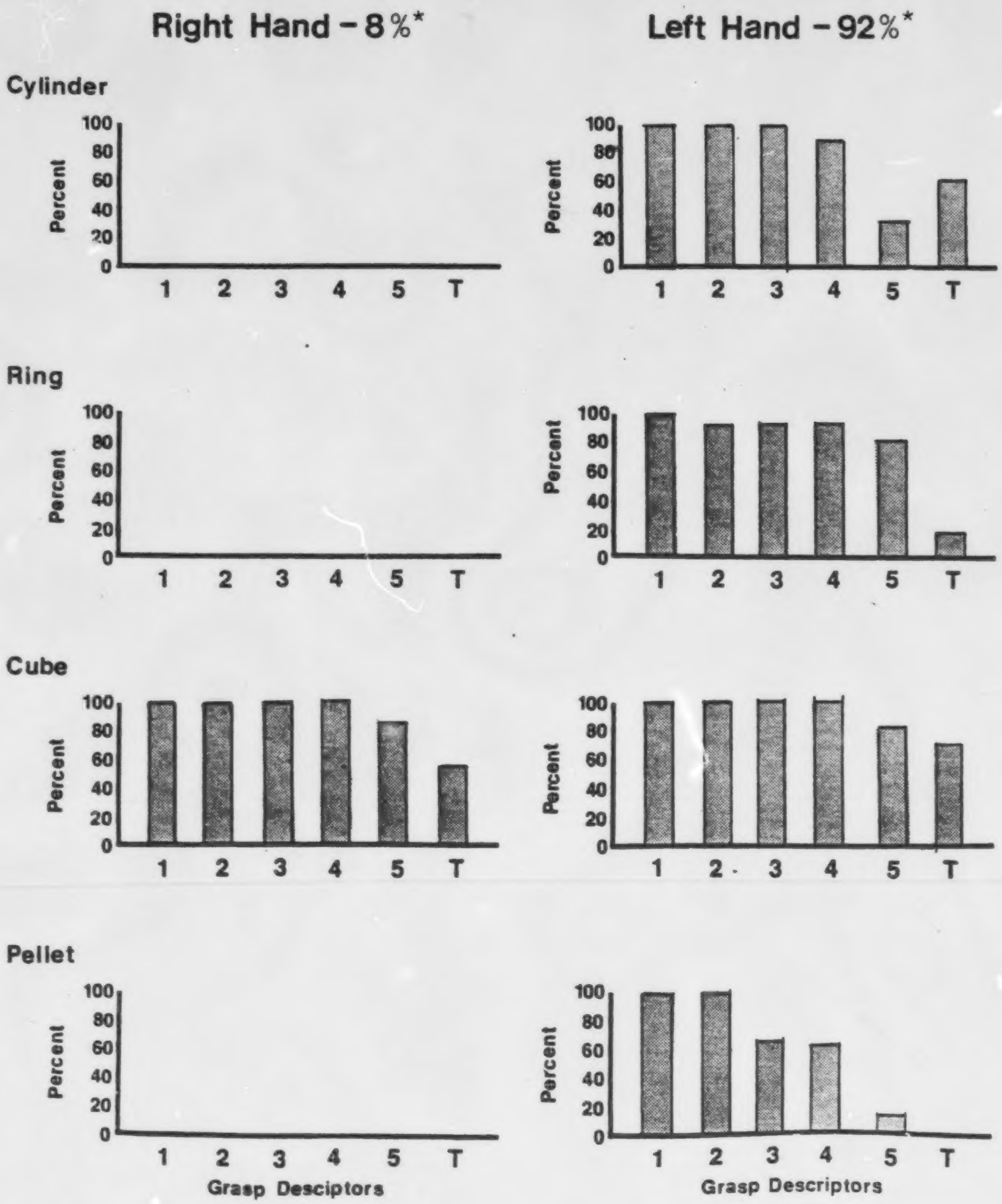

Figure 2: Performance data for Subject 2 in the Sitting Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

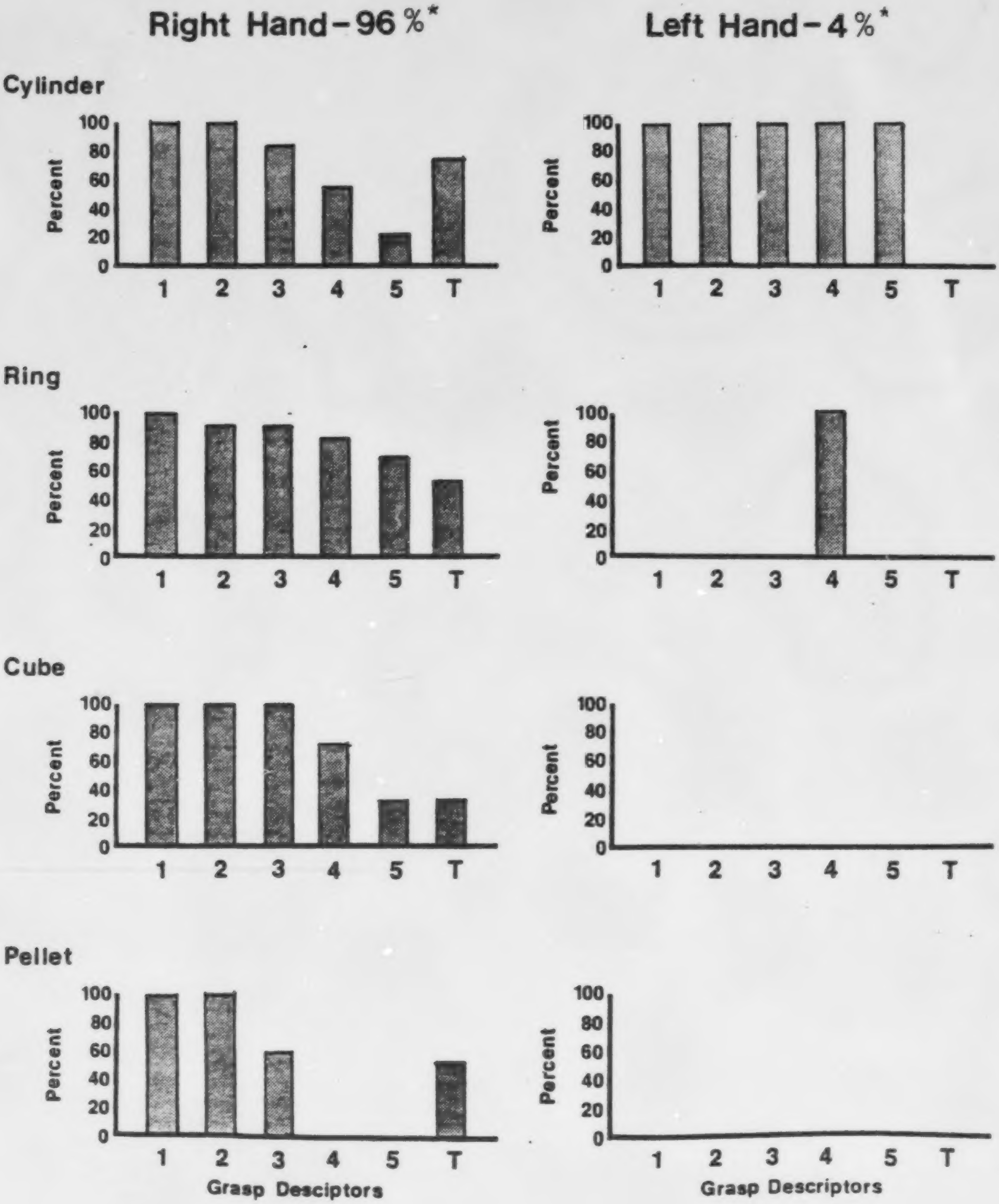

Figure 3: Performance data for Subject 3 in the Sitting Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

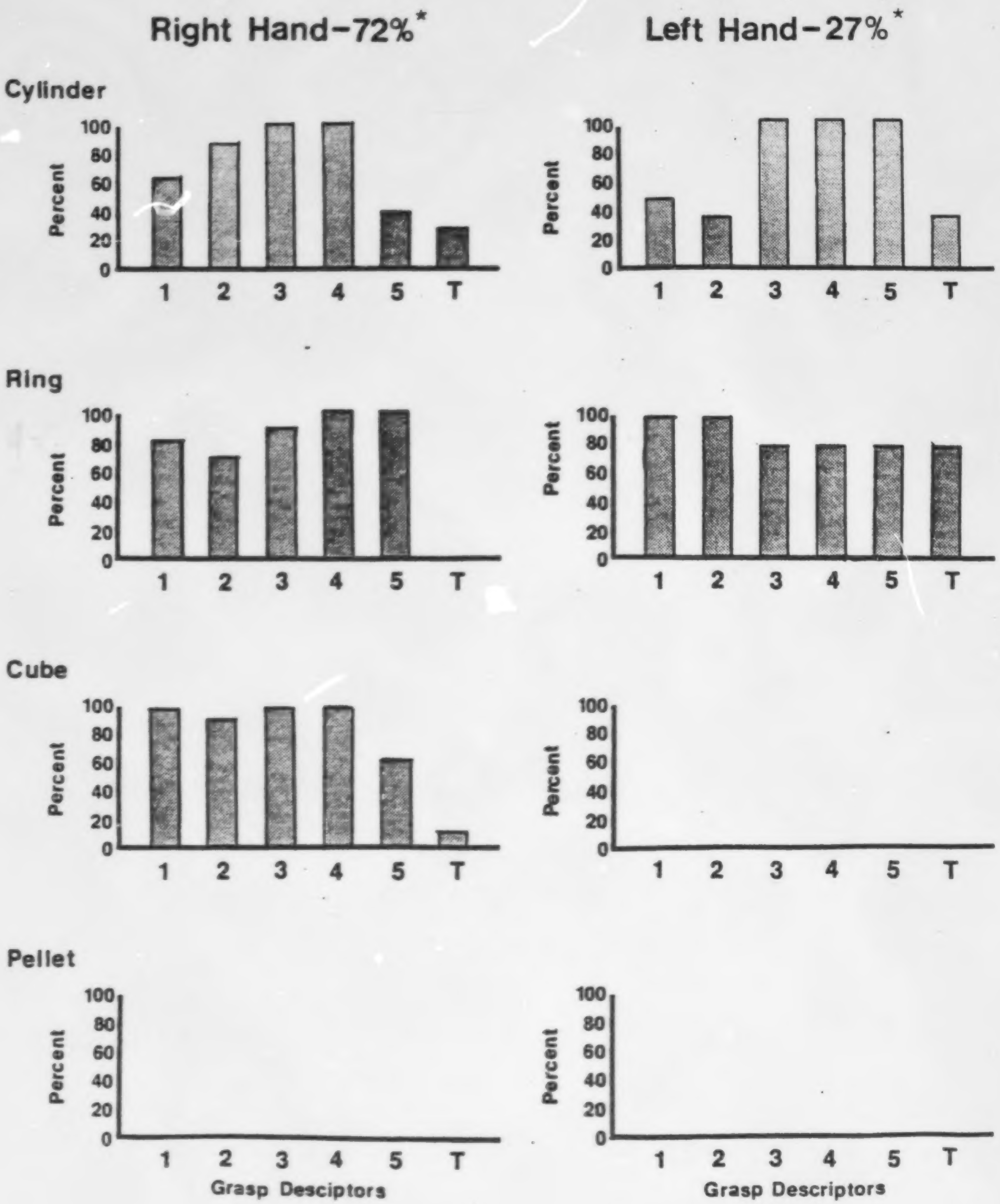

Figure 4: Performance data for Subject 4 in the Sitting Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

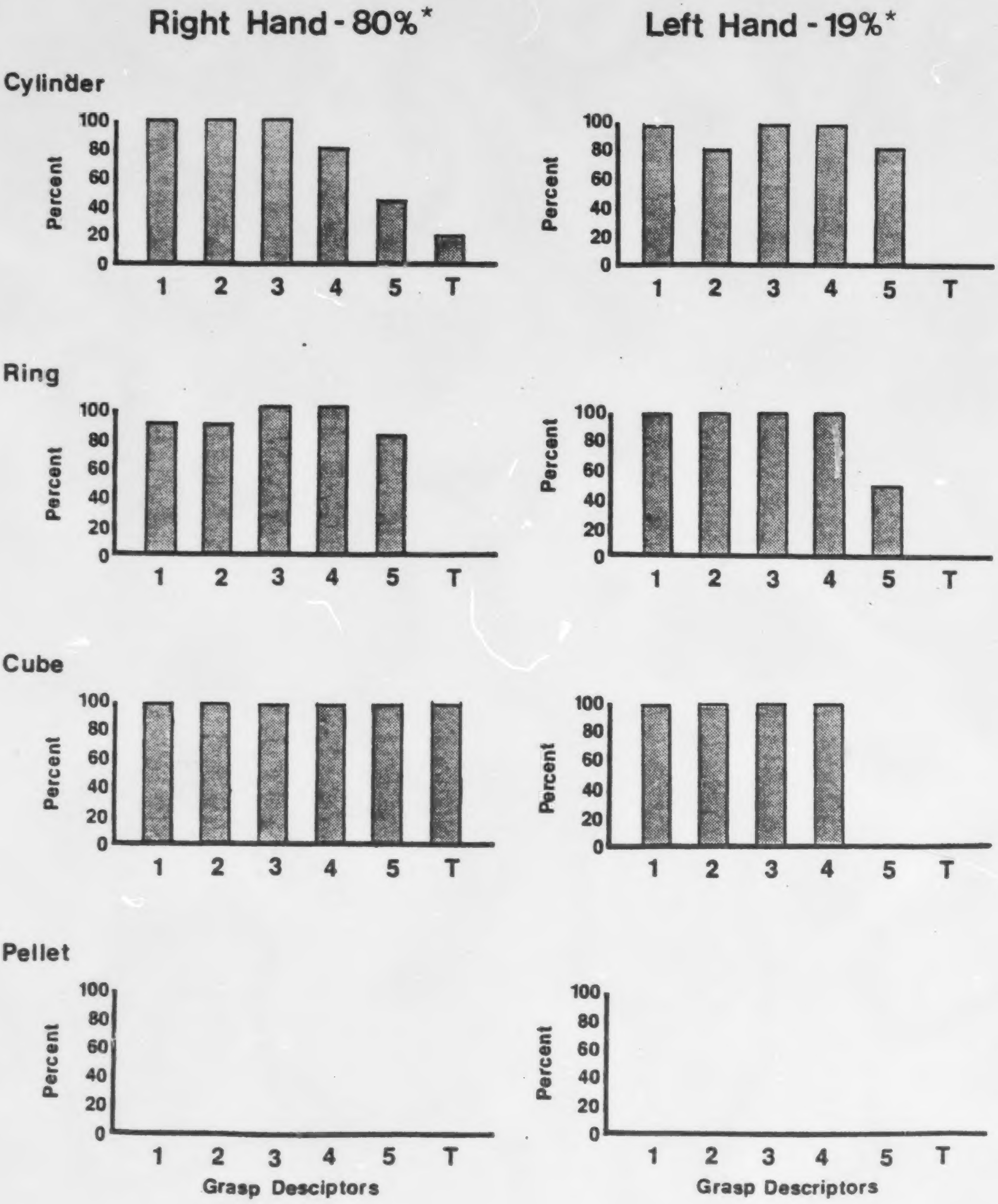

Figure 5: Performance data for Subject 5 in the Sitting Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

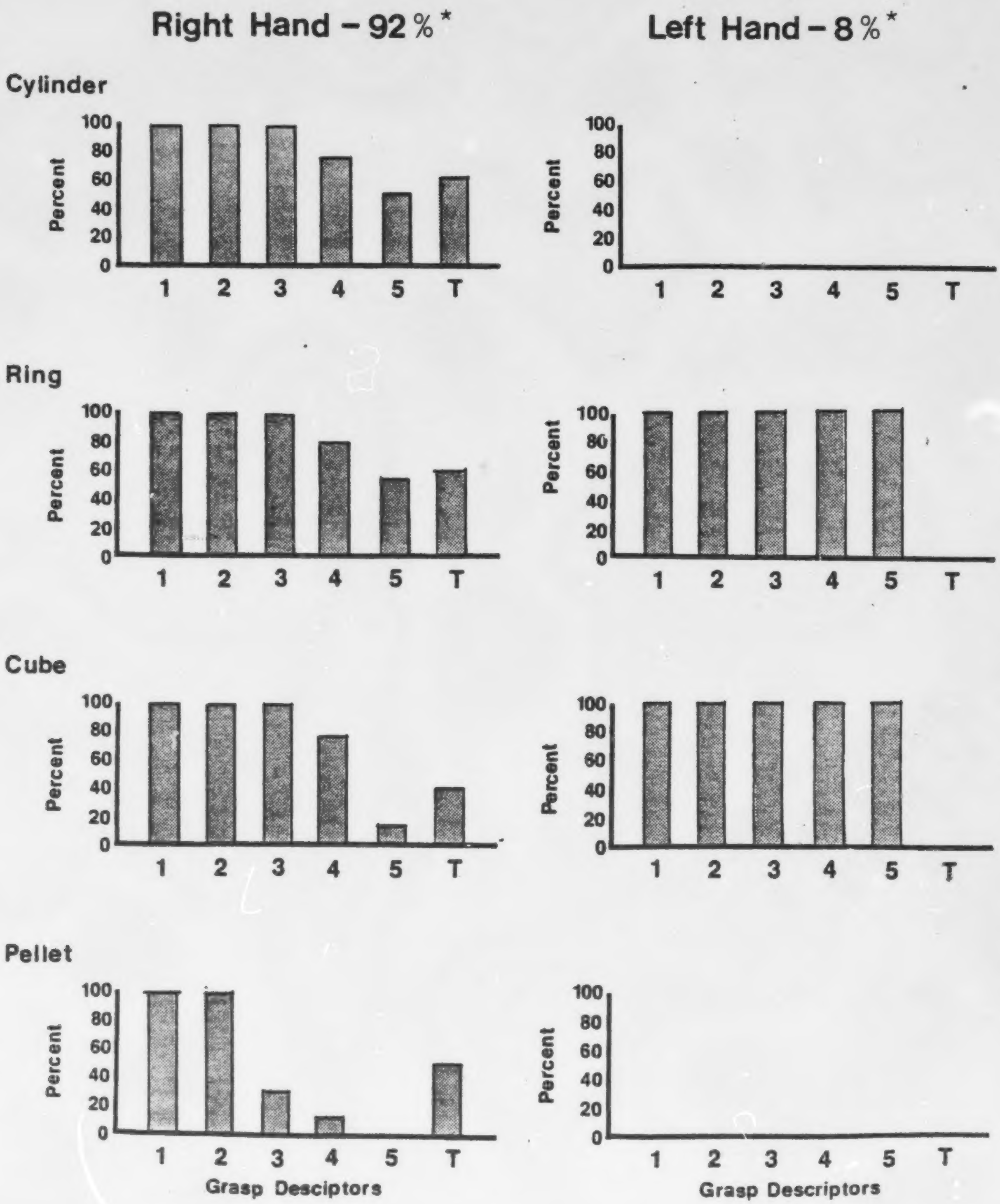

Figure 6: Performance data for Subject 3 in the Standing Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

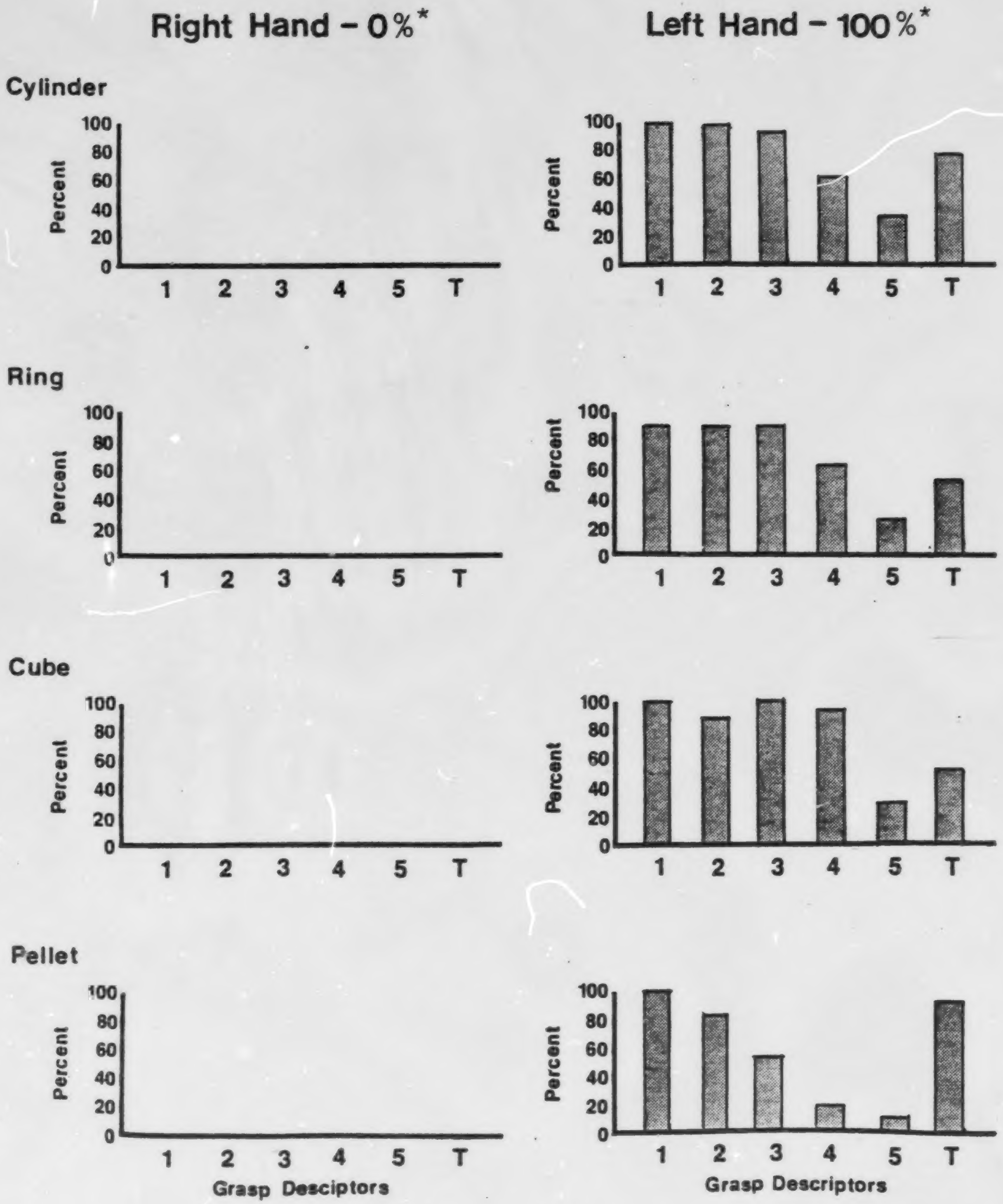

Figure 7: Performance data for Subject 2 in the Right Sidelying Position

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* The numbers in parentheses indicate the percentage of hand useage across all trials.

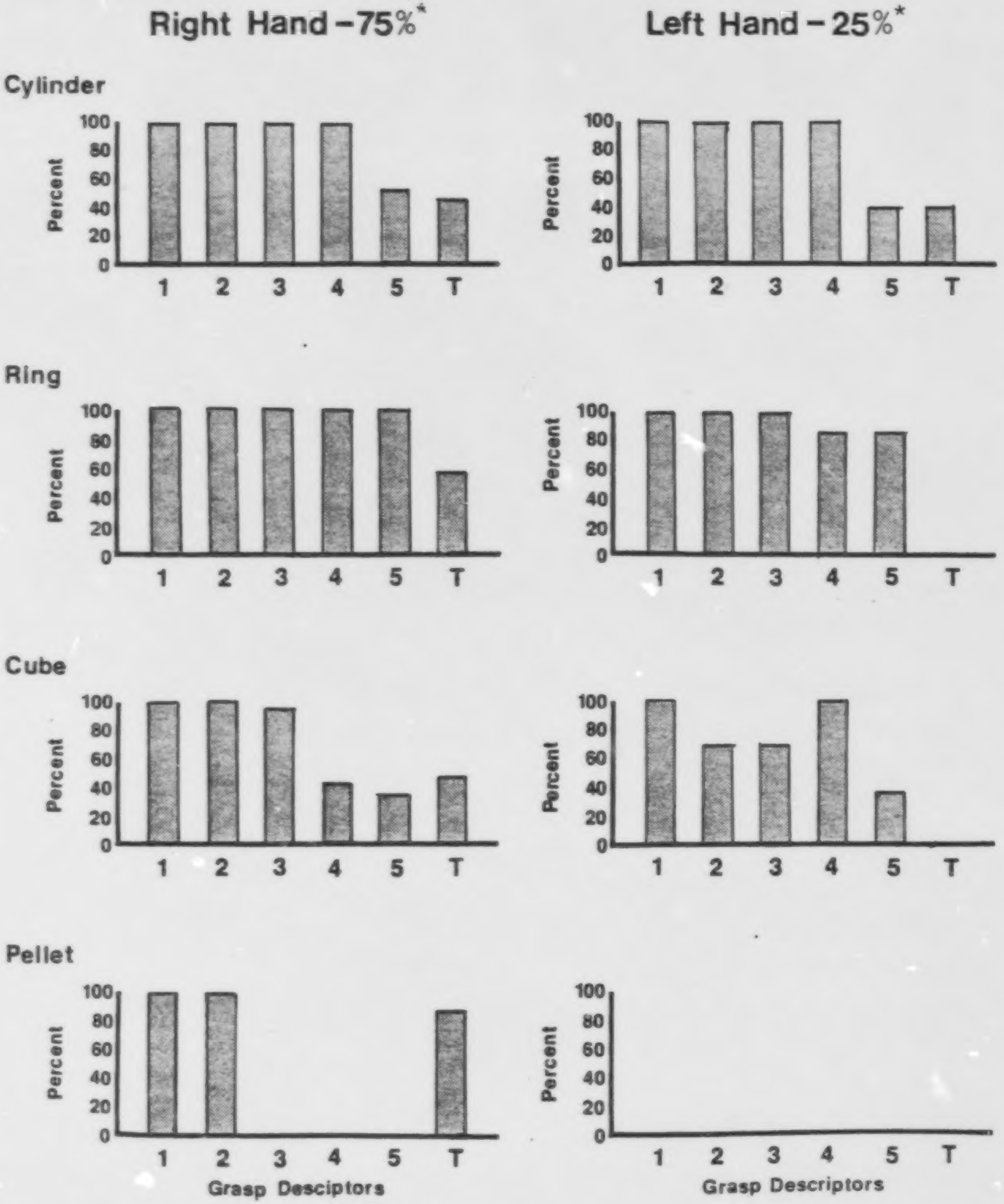

Figure 8: Performance data for Subject 2 in the Left Sidelying Position

*The numbers in parentheses indicate the percentage of hand useage across all trials.

descriptor occurrences over the number of possible occurrence. The bottom number, in parentheses, indicates the ratio as percentage. The (R)ight and (L)eft columns show the actual number of right or left hand use over the total trials (12) for each object the number in parentheses reflects this ratio as the percentage of hand use. The last row shows the percentage of aparticular descriptor use across all four objects for the right or left hand.

Subject 1. Figure 1 illustrates the grasp skill level across descriptors and objects for both the right and left hands. The right hand was used 96% and the left hand was used 4% of the time. Right hand digits 1, 2, 3, and 4 were used an average of 95% to 100% with the cylinder, ring, and cube. The right fifth digit usage ranges from 58% to 90% with an average of 74% for the cylinder, right, and cube. The palm is used to stabilize these first three objects for 100% of the sessions. The pellet grasp topographies reflect 41% tip grasp and use only of the right hand and digits 1, 2, and 3.

Subject 2. Figure 2 illustrates the grasp skill level across descriptors and objects for both the right and left hands. The left hand was used 92% the right was used 8% of the time. The left hand and digits 1, 2, 3, and 4, were most frequently used on the cylinder, ring, and cube. The left fifth digit usage was less frequent, with a range of 16% to 62% on the first three objects. Left hand pellet manipulation was characterized by the thumb and index finger involvement, and 91% tip stabilization. Tip stabilization was less predominant for the first three objects, with a range of 12% to 58%.

Subject 3. Figure 3 illustrates the grasp skill level across descriptors and objects for both the right and left hands. The right hand was used 96% and the left hand was used 4% of the sessions. All four materials reflect a right thumb and index finger predominance of 95% average usage, with a small range of 91% to 100%. The third right digit's average grasp involvement was 76%, with a range of 58% to 90%. Right fourth and fifth digit usage ranged from 18% to 66%. Tip stabilization ranged from 15% to 63% in all four materials, with an average of 48%.

Subject 4. Table 15 reflects the performance data collected and Figure 4 illustrates graphically the grasp skill level across descriptors and objects, for both the right and left hands. The right hand was used 72% of the sessions and the left hand was used in 27% of the sessions. Digits 1 through 4 were used for 90% of the trials, with a range of 66% to 100% for the right hand. The right fifth digit was used 63% of the trials with a range of 33% to 100%. Tip grasp was used 13% of the trials with the right hand. Left hand digit use was similar to the right handed pattern. However, there was an increased fifth digit involvement with the ring and cylinder materials. Tip grasp for the left hand was 11%. Pellet grasp was not present in either the right or left hands for any materials.

Subject 5. Figure 5 illustrates the grasp skill level across descriptors and objects for both the right and left hands. The right hand was used 80% of the sessions and the left hand in 19% of the sessions. Right and left hand digit use was similar for the first four fingers. The average percent of digits 1 though 4 usage was 97% with a range of 95% to 100%; fifth digit involvement ranged from 0% to 100%. Only 7% of all trial grasps were tip grasp. No pellet grasp was present in either right or left hands for any materials.

Performance Results for the Standing Position-Method A

Summarized below is the performance data of one handicapped child in the standing position. The performance graphs are interpreted in the same manner as for the sitting position.

Subject 3. Figure 6 illustrates the grasp skill level across descriptors and objects for both the right and left hands. Right hand usage was 92% and left hand usage was 8%. The first right three digits were used 100% of the time for the cylinder, ring, and cube. The right fourth digit's average use was 74% with a range of 72% to 77% for the cylinder, ring, and cube. Right fifth digit grasp ranges from 9% to 50% usage with an average of 34%. Pellet grasp reflected a predominance of right thumb and index finger involvement of 100%, witn 33% middle digit grasp, 8% ring finger grasp, and no little finger grasp. Tip graps was used on the average of 49% of the time for all four materials, with a range of 36% to 58%.

Performance Results for the Sidelying Positions-Method A

Summarzied below is the performance data for one handicapped subject in the right and left sidelying positions. Performance graphs are interpreted in the same manner as the sitting position.

Subject 2 Right Sidelying position. Figure 7 illustrates the grasp skill level across descriptors and objects for the right and left hands. The left hand was used in 100% of the sessions in this position. The first three digits were used on the cylinder, ring, and cube 93% of the time with a range of 83% to 100%. Pellet grasp topographies reflected 100% thumb use, 75% index finger use, 50% middle finger use, 16% ring finger use, and 8% little finger involvement. Tip grasp was used 62% of all the trial sessions.

Subject 2 Left sidelying position. Figure 8 illustrates the grasp skill level across descriptors and objects for the right and left hands. The left hand was used 25% of the sessions and the right hand was used for 75% of the sessions. The thumb and the index finger were used an average of 93% of the trials for all materials and both hands with a range of 86% to 100%. The third digit was used an average of 74% the fourth digit was used 49%, and the fifth digit was used 35%, across both hands and the cylinder, ring, and cube. Right hand pellet grasp reflected 100% use of the thumb and index fingers. Tip grasp was used 32% of the time between both hands.

Performance Results for the Supported Sitting Position-Method B

Summarized below are the performance results of one handicapped subject assessed in the sitting position utlizing Method B. Method B was used for those subjects who did not have voluntary grasp. Table 19 shows the occurrence or non-occurrence of palmar, radial, or reflexive grasps. When the reflexive grasp occurred the raw data tables show the descriptors involved in the reflexive grasp, in the same manner as for Method A. The performance data are also graphically illustrated, like Method B. However, since Subject 6 responded with a palmar grasp reflexive grasp, these are the only data exhibited.

Subject 6. Figure 9 illustrates the reflexive grasp present across descriptors and objects for both the left and right hands. No response was seen when ulnar or reflexive grasp were tested by any of the four objects. The third and fourth digit of each hand were used for 56% of the trials for palmar reflexive grasp. The first and fifth digit of the left hand were used 44% and 32% of the time respectively for all 16 of the trials. The second digit of the left hand was used only 18% of the time. The first digit of the right hand was used for 25% of the trials while the second right digit was used for 13% and the fifth right digit was used for 18% of the trials.

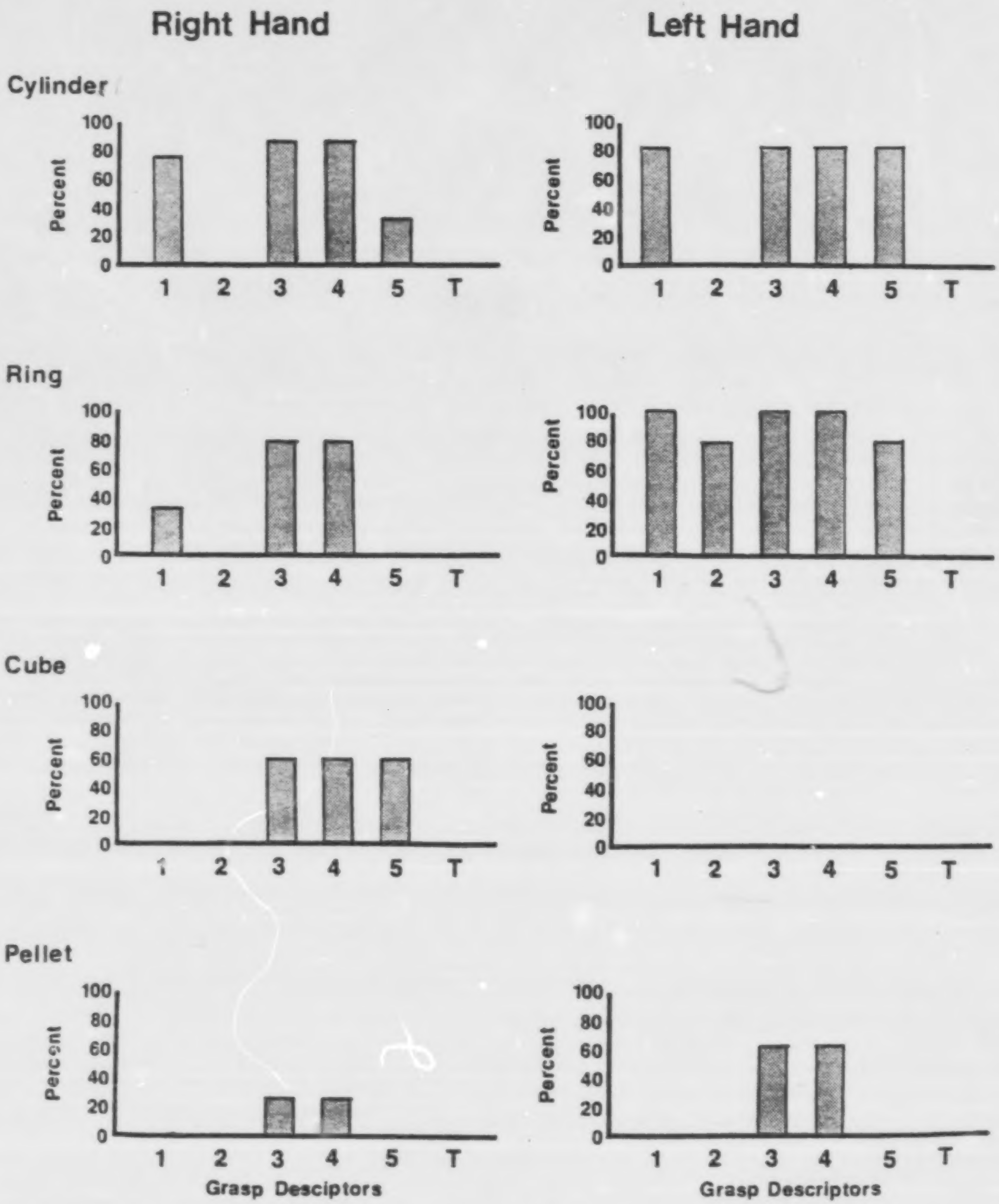

Figure 9: Performance data for Subject 6 in the Sitting Position
Palmar Reflexive Grasp Method B

*The numbers in parentheses indicate the percentage of hand useage across all trials.

Discussion

A discussion of the implications of this study contains a summary of the reliability measures for Methods A and B, a summary of the performance results for Methods A and B, and considerations for further research

Summary of Reliability Measures

The overall reliability of Method A in the sitting position across five children (one non-handicapped and four handicapped) was 88%. No substantial reliability differences were noted between implementing these procedures with students who sit independently and those subjects who required support. However, two of the descriptors proved to be less reliable than the other five. The fifth digit in the sitting or supported sitting position was the least reliable measure, followed by the Palm-Tip descriptor. These two descriptors were more difficult for the observers to distinguish, because often the observer's visual attention is directed towards the thumb side of the hand. There is a question of how important the fifth digit measure actually is. The fifth digit, because of its location on the hand, performs a minimal stabilizing function.

The reliability of Method A in the standing position was 87%. One stimulus object, the pellet, affected the reliability measures more than any other variable in this position for this one subject. No reason for this factor is offered at this time. Tt is felt that further use of this assessment in this position across more handicapped and non-handicapped children would substantiate or repudiate these findings.

The reliability for the right sidelying position was 89% and for left sidelying position was 86%, with the assessment procedure utilized on one child for both positions. The mean reliability of this assessment procedure in the sidelying positions was staisfactory. However, the fourth and fifth digit descriptors were again less reliable than the others. It appears that the sidelying positions, rather than the descriptors or objects, have the greatest negative influence. When a child is in the sidelying positon on the floor, it is extremely difficult for the examiner or observer to position themselves optimally to see the child's entire hand. Placement of the child in the sidelying position on a table top mat, changing table, etc., for assessment may increase the vantage point of the observer and improve the reliability for this position.

The reliability results for Method B appear to be quite high. However, three critical factors need to be considered before the overall representativeness of Method B is established. Although 100% agreement was reached between the examiner and the observers in four different sessions for radial and ulnar reflexive grasp assessment, the agreement was based on nonoccurrence of the radial and ulnar grasp response. The reliability results on palmar grasp assessment are also high. Note that out of the 12 possible trials for each hand for the palmar grasp response, the student responded only 50% of the time. The palmar grasp reliability scores represent agreements 50% of the time between the examiner and the reliability observer on the nonoccurrence of the response. When the response occurred the other 50% of the time, the data were collected.

The grasp patterns for the normal infant at 10 months of age showed a predominance of digit 1, 2, 3, and 4 useage when manipulating the cylinder, ring, or cube. With these three objects the infant used his plam a majority of the time to successfully hold the item. The infant's fifth digit was not used as often. Pellet grasp reflected more fingertip involvement and the infant used his first three digits consistently.

It appeared that the infant was relying on the first three digits consistently and refinement of his prehension response was beginning to emerge as evidence by some fingertip usage and less frequent fifth digit involvement. There was also a significant trend in right hand dominance at this point in time. This subject's skill level was assessed with these procedures as this chronological age seems to reflect the literature's documentation of the order of prehensile skill emergence.

The most obvious problem in the comparison of the performance data of the handicapped student's grasp topographies was their individual prehension differences. These assessment procedures appeared to easily identify objective individual differences in performances across objects in the sitting position. The first two digits were consistently used with the cylinder, ring, and cube. No recognizable pattern was ascertained with the remaining digits' use across subjects for these three stimulus item. However, palmar stabilization was used with regularity. It appeared that the cylinder, ring, and cube, as a function of their size in relationship to the small size of a child's hand, inherently required a palmar grasp stabilization. It appeared that pellet grasp required not only more visual attention, but less finger involvement (because of the pellet's smaller size), and perhap a greater skill dexterity level to secure the item using less hand surface area. In four out of four students, a definite hand laterality was evident. Three students used their right hand a majority of the time and one student used the left hand consistently.

There was no significant different in hand dominance, digit use, or palm or tip stabilization of the one child assessed in the sitting or standing positions. Subject 3's prehensile behaviors appeared to be a consistently present skill exhibiting similar topographies across these two positions.

Subject 6's performance as a result of Method B, indicated that the palmar reflexive grasp was inconsistently present. No radial or ulnar grasp responses were present at the time of the assessment. The stimulus object used to test the response did not seem to affect the response. It is not known whether or not this student will develop a more consistent palmar response, whether or not radial or ulnar grasp had occurred in the past or whether these grasp patterns will appear in the future. No hypothesis on the developmental order of reflexive grasp occurrence is offered from these findings. Method B was limited in its measureable objective findings. Method B, in essence, demonstrated only occurrence or non-occurrance of the response.

Considerations

These procedures should be used to collect data on handicapped and nonhandicapped children on a longitudinal basis for a variety of reasons. Data collected over a series of weeks and months will provide valuable information to the classroom teacher on the child's rate of acquisiton, changes skill level, the effects of educational programming as well as a more comprehensive view of these procedures' reliability over time, trainers, and individual children. In addition, longitudinal data will establish of these are patterns of emerging grasp behaviors in handicapped children. These data may show a different prehension developmental progression for the handicapped child than the current literature documentation of normal prehension development. Data collected in unstructured settings at home, in the classroom or in the community will also reflect the child's degree of prehensile skill generalization across settings.

Another research possibility include data collection on both the left and right hands for both handicapped and non-handicapped students. These data may further substantiate the assumption that hand preference occurs early on and that the preferred hand demonstrates a higher skill level than the less preferred hand. The higher skill level of the preferred hand would be topographically exhibited in greater radial digit use and more fingertip stabilization.

APPENDIX A

Table 12

Performance Results for Subject 1
in the Sitting Position

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	$\frac{10}{10}$[1]	$\frac{10}{10}$	$\frac{10}{10}$	$\frac{10}{10}$	$\frac{9}{10}$	$\frac{0}{12}$	$\frac{10}{12}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{0}{2}$	$\frac{0}{12}$
	100[2]	100	100	100	90	0	83	100	100	100	100	100	0	100
Ring	$\frac{12}{12}$	$\frac{11}{12}$	$\frac{12}{12}$	$\frac{11}{12}$	$\frac{7}{12}$	$\frac{6}{12}$	$\frac{12}{12}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$
	100	91	100	91	58	0	100	0	0	0	0	0	0	0
Cube	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{9}{12}$	$\frac{0}{12}$	$\frac{12}{12}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$
	100	100	100	100	75	0	100	0	0	0	0	0	0	100
Pellet	$\frac{10}{12}$	$\frac{9}{12}$	$\frac{5}{12}$	$\frac{0}{12}$	$\frac{0}{12}$	$\frac{5}{12}$	$\frac{12}{12}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$
	83	75	41	0	0	41	100	0	0	0	0	0	0	0
% of Descriptor Use Across Objects	95	91	85	72	55	10	96	100	100	100	100	100	100	4

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 13

Performance Results for Subject 2 in the Sitting Position

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	$\frac{0}{0}$[1]	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{10}{12}$	$\frac{3}{12}$	$\frac{7}{12}$	$\frac{12}{12}$
	0[2]	0	0	0	0	0	0	100	100	100	83	25	58	100
Ring	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$	$\frac{12}{12}$	$\frac{11}{12}$	$\frac{11}{12}$	$\frac{11}{12}$	$\frac{10}{12}$	$\frac{2}{12}$	$\frac{12}{12}$
	0	0	0	0	0	0	0	100	91	91	91	83	16	100
Cube	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{4}{4}$	$\frac{8}{8}$	$\frac{8}{8}$	$\frac{8}{8}$	$\frac{8}{8}$	$\frac{6}{8}$	$\frac{5}{8}$	$\frac{8}{8}$
	100	100	100	100	75	50	100	100	100	100	100	75	62	100
Pellet	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{8}{12}$	$\frac{7}{12}$	$\frac{1}{12}$	$\frac{0}{12}$	$\frac{12}{12}$
	0	0	0	0	0	0	0	100	100	66	58	8	0	100
% of Descriptor Use Across Objects	100	100	100	100	75	50	8	100	97	89	83	47	34	92

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[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 14

Performance Results for Subject 3 in the Sitting Position

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	$\frac{11}{11}$[1]	$\frac{11}{11}$	$\frac{9}{11}$	$\frac{6}{11}$	$\frac{2}{11}$	$\frac{7}{11}$	$\frac{11}{12}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{0}{1}$	$\frac{1}{12}$
	100[2]	100	81	54	18	63	91	100	100	100	100	100	0	9
Ring	$\frac{11}{11}$	$\frac{10}{11}$	$\frac{10}{11}$	$\frac{9}{11}$	$\frac{7}{11}$	$\frac{6}{11}$	$\frac{11}{12}$	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{1}{1}$	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{1}{12}$
	100	90	90	81	63	54	91	0	0	0	100	0	0	9
Cube	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{8}{12}$	$\frac{3}{12}$	$\frac{3}{12}$	$\frac{12}{12}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$
	100	100	100	66	25	25	100	0	0	0	0	0	0	0
Pellet	$\frac{12}{12}$	$\frac{12}{12}$	$\frac{7}{12}$	$\frac{0}{12}$	$\frac{0}{12}$	$\frac{6}{12}$	$\frac{12}{12}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{12}$
	100	100	58	0	0	50	100	0	0	0	0	0	0	0
% of Descriptor Use Across Objects	100	98	82	50	27	48	96	50	50	50	100	50	0	4

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[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 15

Performance Results for Subject 4
in the Sitting Position

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	$\frac{4}{6}$[1] 66[2]	$\frac{5}{6}$ 83	$\frac{6}{6}$ 100	$\frac{6}{6}$ 100	$\frac{2}{6}$ 33	$\frac{2}{6}$ 33	$\frac{6}{12}$ 50	$\frac{3}{6}$ 50	$\frac{2}{6}$ 33	$\frac{6}{6}$ 100	$\frac{6}{6}$ 100	$\frac{6}{6}$ 100	$\frac{2}{6}$ 33	$\frac{6}{12}$ 50
Ring	$\frac{7}{8}$ 87	$\frac{6}{8}$ 75	$\frac{7}{8}$ 87	$\frac{8}{8}$ 100	$\frac{8}{8}$ 100	$\frac{0}{8}$ 0	$\frac{8}{12}$ 66	$\frac{4}{4}$ 100	$\frac{4}{4}$ 100	$\frac{3}{4}$ 75	$\frac{3}{4}$ 75	$\frac{3}{4}$ 75	$\frac{3}{4}$ 75	$\frac{4}{12}$ 33
Cube	$\frac{12}{12}$ 100	$\frac{11}{12}$ 91	$\frac{12}{12}$ 100	$\frac{12}{12}$ 100	$\frac{7}{12}$ 58	$\frac{1}{12}$ 8	$\frac{12}{12}$ 100	$\frac{0}{0}$ 0	$\frac{0}{0}$ 0	$\frac{0}{0}$ 0	$\frac{0}{0}$ 0	$\frac{0}{0}$ 0	$\frac{0}{0}$ 0	$\frac{0}{12}$ 0
Pellet	No Grasp							No Grasp						
% of Descriptor Use Across Objects	84	83	95	100	63	13	72	50	44	58	58	58	11	27

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 16

Performance Results for Subject 5 in the Sitting Position

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	$\frac{8}{8}$[1]	$\frac{8}{8}$	$\frac{8}{8}$	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{8}$	$\frac{8}{12}$	$\frac{4}{4}$	$\frac{3}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{3}{4}$	$\frac{0}{4}$	$\frac{4}{12}$
	100[2]	100	100	87	41	12	66	100	75	100	100	75	0	33
Ring	$\frac{9}{10}$	$\frac{9}{10}$	$\frac{10}{10}$	$\frac{10}{10}$	$\frac{8}{10}$	$\frac{0}{10}$	$\frac{10}{12}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{1}{2}$	$\frac{0}{2}$	$\frac{2}{12}$
	90	90	100	100	80	0	83	100	100	100	100	50	0	16
Cube	$\frac{11}{11}$	$\frac{11}{11}$	$\frac{11}{11}$	$\frac{11}{11}$	$\frac{11}{11}$	$\frac{11}{11}$	$\frac{11}{12}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{1}{1}$	$\frac{0}{1}$	$\frac{0}{1}$	$\frac{1}{12}$
	100	100	100	100	100	100	91	100	100	100	100	0	0	8
Pellet	No Grasp							No Grasp						
% of Descriptor Use Across Objects	97	97	100	96	74	28	80	100	92	100	100	42	0	19

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[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 17

Performance Results for Subject 3 in the Standing Position

Stimulus Materials	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	12/12[1]	12/12	12/12	9/12	9/12	7/12	12/12	0/0	0/0	0/0	0/0	0/0	0/0	0/12
	100[2]	100	100	75	50	58	100	0	0	0	0	0	0	0
Ring	9/9	9/9	9/9	7/9	4/9	5/9	9/12	3/3	3/3	3/3	3/3	3/3	0/3	3/12
	100	100	100	77	44	55	75	100	100	100	100	100	0	25
Cube	11/11	11/11	11/11	8/11	1/11	4/11	11/12	1/1	1/1	1/1	1/1	1/1	0/1	1/12
	100	100	100	72	9	36	91	100	100	100	100	100	0	9
Pellet	12/12	12/12	4/12	1/12	0/12	6/12	12/12	0/0	0/0	0/0	0/0	0/0	0/0	0/12
	100	100	33	8	0	50	100	0	0	0	0	0	0	0
% of Descriptor Use Across Objects	100	100	83	58	26	50	92	50	50	50	50	50	0	8

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 18

Performance Results for Subject 2 in the Right Sidelying Position with the Left Arm on Top

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	0/0[1] 0[2]	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/12 0	12/12 100	12/12 100	11/12 91	7/12 58	3/12 25	9/12 75	12/12 100
Ring	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/12 0	11/12 91	11/12 91	11/12 91	7/12 58	3/12 25	6/12 50	12/12 100
Cube	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/12 0	12/12 100	10/12 83	12/12 100	10/12 83	4/12 33	4/12 33	12/12 100
Pellet	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/12 0	12/12 100	9/12 75	6/12 50	2/12 16	1/12 8	11/12 91	12/12 100
% of Descriptor Use Across Objects	0	0	0	0	0	0	0	97	87	83	53	22	62	100

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 19

Performance Results for Subject 2 in the Left Sidelying Position with the Right Arm on Top

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	9/9[1]	9/9	9/9	9/9	4/9	3/9	9/12	3/3	3/3	3/3	3/3	1/3	1/3	3/12
	100[2]	100	100	100	44	33	75	100	100	100	100	33	33	25
Ring	6/6	6/6	6/6	6/6	6/6	3/6	6/12	6/6	6/6	6/6	5/6	5/6	0/6	6/12
	100	100	100	100	100	50	50	100	100	100	83	83	0	50
Cube	9/9	9/9	8/9	4/9	3/9	4/9	9/12	3/3	2/3	2/3	3/3	1/3	0/3	3/12
	100	100	88	44	33	44	75	100	66	66	100	33	0	25
Pellet	12/12	12/12	0/12	0/12	0/12	10/12	12/12	0/0	0/0	0/0	0/0	0/0	0/0	0/12
	100	100	0	0	0	83	100	0	0	0	0	0	0	0
% of Descriptor Use Across Objects	100	100	72	61	44	52	75	75	66	66	70	37	8	25

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

Table 20

Performance Results for Subject 6
in the Supported Sitting Position
Testing Palmar Reflexive Grasp with Method B

Stimulus Material	Right Hand							Left Hand						
	Descriptors													
	1	2	3	4	5	T	R	1	2	3	4	5	T	L
Cylinder	3/4[1] 75[2]	0/4 0	3/4 75	3/4 75	1/4 25			3/4 75	0/4 0	3/4 75	3/4 75	3/4 75		
Ring	1/4 25	0/4 0	3/4 75	3/4 75	0/4 0			4/4 100	3/4 75	4/4 100	4/4 100	2/4 50		
Cube	0/4 0	0/4 0	2/4 50	2/4 50	2/4 50			0/4 0	0/4 0	0/4 0	0/4 0	0/4 0		
Pellet	0/4 0	0/4 0	1/4 25	1/4 25	0/4 0			0/4 0	0/4 0	2/4 50	2/4 50	0/4 0		
% of Descriptor Use Across Objects	25	0	56	56	19			44	19	56	56	31		

[1] The ratio of the number of times the descriptor was used over the number of trials in which that hand was used for each stimulus object.

[2] The above ratio expressed as the percentages graphed in Figures 1 through 19.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE TRANSFER BEHAVIORS AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped Infant and Three Handicapped Preschoolers[1]

by

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and

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[1] The procedures and data reported in this study were taken from a Master's thesis by Ellen Mellard submitted to the Department of Special Education, the University of Kansas, in the Spring, 1980.

Overview of the Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages FM(T) 1 through FM(T) 25 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to measure the responses involved in the development of a transfer response. They were demonstrated on children in three different body positions; sitting and supported sitting, supine, and standing. Measures were taken on the type, latency, and location of manipulations of both large and small objects across right and left presentation sides.

The types of manipultions observed were: an independent transfer, transfer using a third surface, holding the object in both hands, taking the object to the mouth, holding the object in the receiving hand, dropping the object, or crossing over with the other hand to receive the object. In addition, the location of these responses in relation to the child's body were also recorded as to the left, right, or middle of the body. The third type of information scored was whether the response occurred at the end of five or ten second time periods. Each child was observed in one or two of his/her most functional body positions across four observation sessions.

The procedures involved two methods to elicit a transfer response, both procedures involved a priming or put-through before beginning the actual assessment trials. The two procedures involved presenting an object to the child's left or right side and either 1) moving to the child's opposite side and asking for the oject, or 2) presenting a more highly liked object to the same side as the initial object. The procedure that worked best for each child should be used. Emphasis was on eliciting the transfer response, the manner in which this was done remained flexible and varied within a session. The child had ten seconds in which to respond. The examiner scores the type of response at the end of the first and second five second periods. If a transfer, transfer using a third surface, or a drop occurs, the trial ended.

Subjects

This study included both handicapped preschoolers and a non-handicapped infant. Selection criteria for each child included having some functional use of both upper extremities and the behavior of grasping and interacting with objects.

Subject 1. Molly was a normally developing female who was observed from 7 to 8 months of age.

Subject 2. Joy was a three and one half year old female with left spastic hemiparesis, seizure disorder, and developmental delay. On the Bayley Scales (Bayley, 1969) she was functioning between the five and seven months level. She used a radial-palmar grasp with the right hand and a palmar grasp with the left hand. Joy seldom interacted with toys. She did shake and bang objects when holding them. She has been observed to transfer objects infrequently in a free play situation.

Subject 3. Michael was a four year old male with spastic quadraparesis having more impariment on his left side. On the Bayley Scales, Michael was functioning at the 28 month level, although his gross motor skills were at approximately the seven to nine months level and fine motor skills were scattered to the 18 month level. Michael released objects into a container and manipulated simple puzzles. He was unable to stack one inch cubes. Michael did transfer in a free play situation. He generally used a radial palmar grasp.

Subject 4. Ricci was a five and one half year old male with spastic quadraplegia. According to the Bayley Scales he was functioning between the six and eight month level. Ricci ususally approached objects with one hand and held it using a whole hand graps. He did not have a controlled release. Ricci mouthed all objects he attained and has not been observed to transfer objects.

Procedures for Obtaining Measures of Reliability

Interobserver reliabilities were calculated for subjects' transfer skills. They were computed in the same manner for each body position in which the transfer skills were measured.

The observer sat next to the examiner with a clipboard, data sheet and pencil. During the trials, the observer moved around as needed for a good view of the child's movement. Once the trial began, there was no verbal disucssion between the observer and the examiner. When the trial was over, the observer and the examiner recorded the type of transfer response and the trisection in which that response occurred for both the 5 and 10 second intervals. The examiners observed only the subject and did not confer with one another during the trials. During trials when the child was noncomplaint or obviously not attending to the stimulus, the examiner discontinued the trial and neither the examiner nor the observer recorded the observations.

Upon completion of a session, reliability was determined for each object size and side presentation i.e. large object presented on the left side per subject. Reliability was computed according to the following formula:

$$\frac{\text{agreements}}{\text{agreements + disagreements}} \quad \text{X } 100 \quad = \text{reliabiltiy}$$

For each behavior that had an opportunity to be scored the number of agreements was divided by the number of agreements plus the number of disagreements and multiplied by 100 to obtain the reliability score for each trial. The sum of the reliability scores for each trial in each session was summed and divided by the total number of trials to calculate the overall reliability for each session. Each student was observed a total of 4 times with 2 different observers used to obtain the reliability on each pair of observations. After completing 4 sessions, mean interobserver reliability was computed across the 4 sessions for each subject. This measure provided interobserver agreement for each subject across the 4 sessions. As a specific measure, reliability was calculated for each stimulus condition.

Results

Measures of Interobserver Reliability

The interobserver reliability data for each subject are contained in Tables 1 through 5. A description of how to read the tables, what the scores mean, and reliability information is presented. The first row titled Object, indicates the size of the object, small or large, which was presented to the subject. The sub rows for Object, labled Presentation Side, indicate the position, Left or Right, from which the item was presented to the subject. The subrows for Side, titled Time Lapsed in Seconds, indicates the number of seconds, 5 or 10, at which the responses were scored. Responses were scored at the end of the five second period and/or at the end of the ten second period. The columns are identified as Transfer and Position. Each column contains sub-columns indicating the reliability of the transfer measure for each time interval and the total reliability. The Transfer column reliability data represents agreement on the hierarchy of transfer descriptors found on the data sheet. The Position column data represent agreement on the

Table 1

Percentage Reliability Scores for Subject 1
in the Unsupported Sitting Position

Object Size	Presentation Side	Time Lapsed in Seconds	Transfer Response		Position		Row Mean Reliability
			Per Time Period	Total	Per Time Period	Total	
Small	Left	5	83	83	83	83	83
		10	83		83		
	Right	5	83	88	92	92	90
		10	92		92		
Large	Left	5	88	90	92	92	91
		10	92		92		
	Right	5	92	96	92	96	96
		10	100		100		
Column Mean Reliability			89	89	91	91	90

Table 2

Percentage Reliability Scores for Subject 2 in the Supported Standing Position

Object Size	Presentation Side	Time Lapsed in Seconds	Transfer Response		Position		Row Mean Reliability
			Per Time Period	Total	Per Time Period	Total	
Small	Left	5	100	100	92	75	87
		10	100		58		
	Right	5	83	88	92	96	92
		10	92		100		
Large	Left	5	100	96	83	83	89
		10	92		83		
	Right	5	83	83	83	88	85
		10	83		92		
Column Mean Reliability			89	89	91	91	90

Table 3

Percentage Reliability Scores for Subject 3
in the Supported Sitting Position

Object Size	Presentation Side	Time Lapsed in Seconds	Transfer Response		Position		Row Mean Reliability
			Per Time Period	Total	Per Time Period	Total	
Small	Left	5	83	83	100	100	91
		10	83		100		
	Right	5	100	100	92	96	98
		10	100		100		
Large	Left	5	100	100	83	88	94
		10	100		92		
	Right	5	100	100	58	75	87
		10	100		92		
Column Mean Reliability			96	96	88	90	92

Table 4

Percentage Reliability Scores for Subject 4

in the Supported Sitting Position

Object Size	Presentation Side	Time Lapsed in Seconds	Transfer Response		Position		Row Mean Reliability
			Per Time Period	Total	Per Time Period	Total	
Small	Left	5	96	98	100	100	99
		10	100		100		
	Right	5	98	96	96	98	97
		10	92		100		
Large	Left	5	100	100	98	96	98
		10	100		92		
	Right	5	100	94	83	91	92
		10	88		100		
Column Mean Reliability			97	97	96	96	95

Table 5

Percentage Reliability Scores for Subject 4 in the Supine Position

Object Size	Presentation Side	Time Lapsed in Seconds	Transfer Response		Position		Row Mean Reliability
			Per Time Period	Total	Per Time Period		
Small	Left	5	100	100	100	100	100
		10	100		100		
	Right	5	100	100	100	100	100
		10	100		100		
Large	Left	5	83	92	92	92	92
		10	100		92		
	Right	5	100	88	100	100	94
		10	75		100		
Column Mean Reliability			95	95	97	97	96

three position codes from the data sheet; 1, 2, 3.

Reliability data for the transfer response, for each object, with left or right side presentation at the end of the five or ten seconds are presented in the column titled Transfer Response, subtitled Per Time Period. Reliability for both the five and ten second time lapse conbined with the left or right hand are presented in the column titled Transfer Response, subtitled Total. Reliability data for the position with left or right side presentation of the stimulus at the end of five or ten seconds are presented in the column titled Position, subtitled Per Time Period. The reliability data for the Position combined for both the five and ten second time lapse for the left and right hand are presented in the column titled Position, subtitle Total.

The mean percentage for each object size and side of presentation is presented at the far right column under Row Mean Reliability. Column mean reliability for the descriptor and response position across stimulus positions, object size and time lapse for the four sessions are presented in the row labeled Column Mean Reliability.

The number entered in the lower right corner represents session mean reliability of all objects, stimulus positions, and time lapse, across the transfer response and response position for four consequentive observations for each child in one body position.

Subject 1 (Molly).

Supported Sitting Position: The reliability data for Subject 1 are presented in Table 1. The range of reliability scores for the transfer behaviors for small objects was from 83% to 92%, and for large objects 88% to 100%. The range of reliability scores for the response position of small objects was 83% to 92% and for large objects from 92% to 100%.

Overall mean interobserver reliability, for all measures for Subject 1 was 90%.

Subject 2 (Joy).

Supported Standing Position: Table 2 presents the reliability data for Subject 2 in the supported standing position. The range of reliability scores for the transfer behaviors for small objects was from 83% to 100% and for large objects from 83% to 100%. The range of reliability scores for the response position of small objects was 58% to 100%, and of large objects from 83% to 92%. Overall mean interobserver reliability for all measures for Subject 2 was 88% with a range of 58% to 100%.

Subject 3 (Michael).

Supported Sitting: Table 3 presents the reliability data for Subject 3 in the supported sitting position. The range of reliability scores for the transfer behaviors for small objects was from 83% to 100%, and for large objects was 100%. The range of reliability scores for the trisection position of small objects was from 92% to 100%, and for large objects from 58% to 92%. Overall mean interobserver reliability for all measures for Subject 3 was 92% with a range of 58% to 100%.

Subject 4 (Ricci).

Supported Sitting: Table 4 presents the reliability information for Subject 4 in the supported sitting position. The range of reliability scores for the transfer behaviors for small objects was from 92% to 100%, and for large objects was 88% to 100%. The range of reliability scores for the trisection position of small objects was 96% to 100%, and for large objects 83% to 100%. Overall mean interobserver reliability for all measures for Subject 4 was 95% with a range of 83% to 100%.

Supine: Table 5 presents the reliability data for Subject 4 in the supine position. The reliability scores for the transfer behaviors for small objects was 100% and for large objects ranged from 75% to 100%. The reliability for the trisection positon of small objects was 100% and for large objects ranged from 92% to 100%. Overall mean interobserver reliability for all measures for Subject 4 was 96% with a range from 75% to 100%.

Performance Data on Transfer Responses

The performance data for each subject are presented in Figures 1 through 5. Four bar graphs for each subject per body position assessed are presented. These figures represent the percentage of times the subject performed each of the transfer discriptiors when presented with a small or large object, to either the left or right side. Transfer skill descriptors are arranged with the most skilled level of transfer behavior to the left and with the lowest level of transfer behavior to the right. The descriptors include: T (transfer): TS (transfer using a third surface); BH (both hands); M (mouth); H (hold); D (drop); C (cross); 1 (first trisection); 2 (second trisection); and 3 (third trisection).

Subject 1 (Molly).

Unsupported sitting position: Figure 1 presents the transfer performance data for Subject 1 in the unsupported sitting position. Molly transferred the small object 25% of the time within five seconds, and the large object 8% of the time in the first five seconds when presented at the left and 25% of the time when presented at the right. The response which Molly most frequently displayed at the end of the first five seconds was a hold response. Molly transfered the object 33% more often when it

FM(T)14

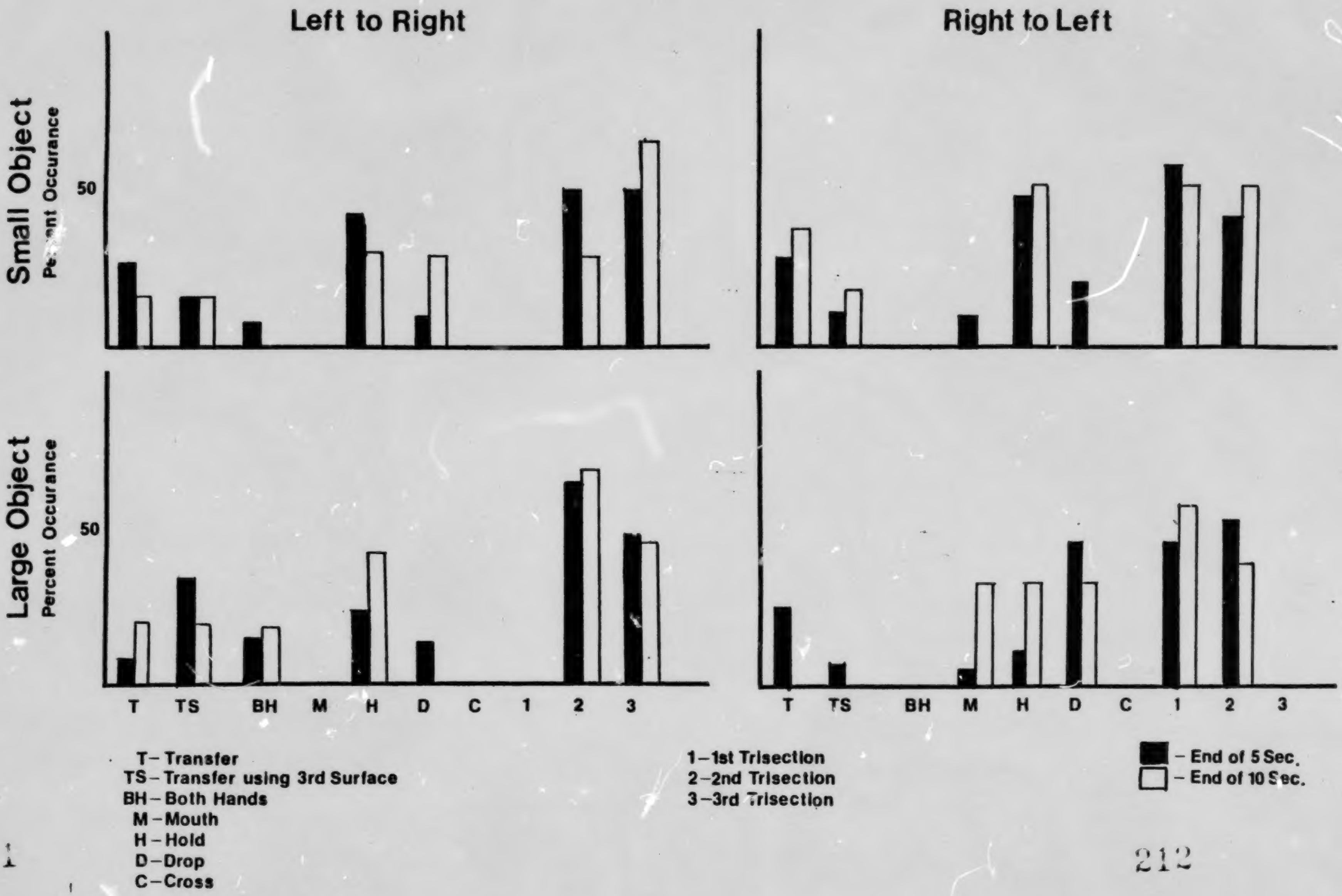


Figure 1: Transfer Performance of Subject 1 in Unsupported Sitting

FM(T)15

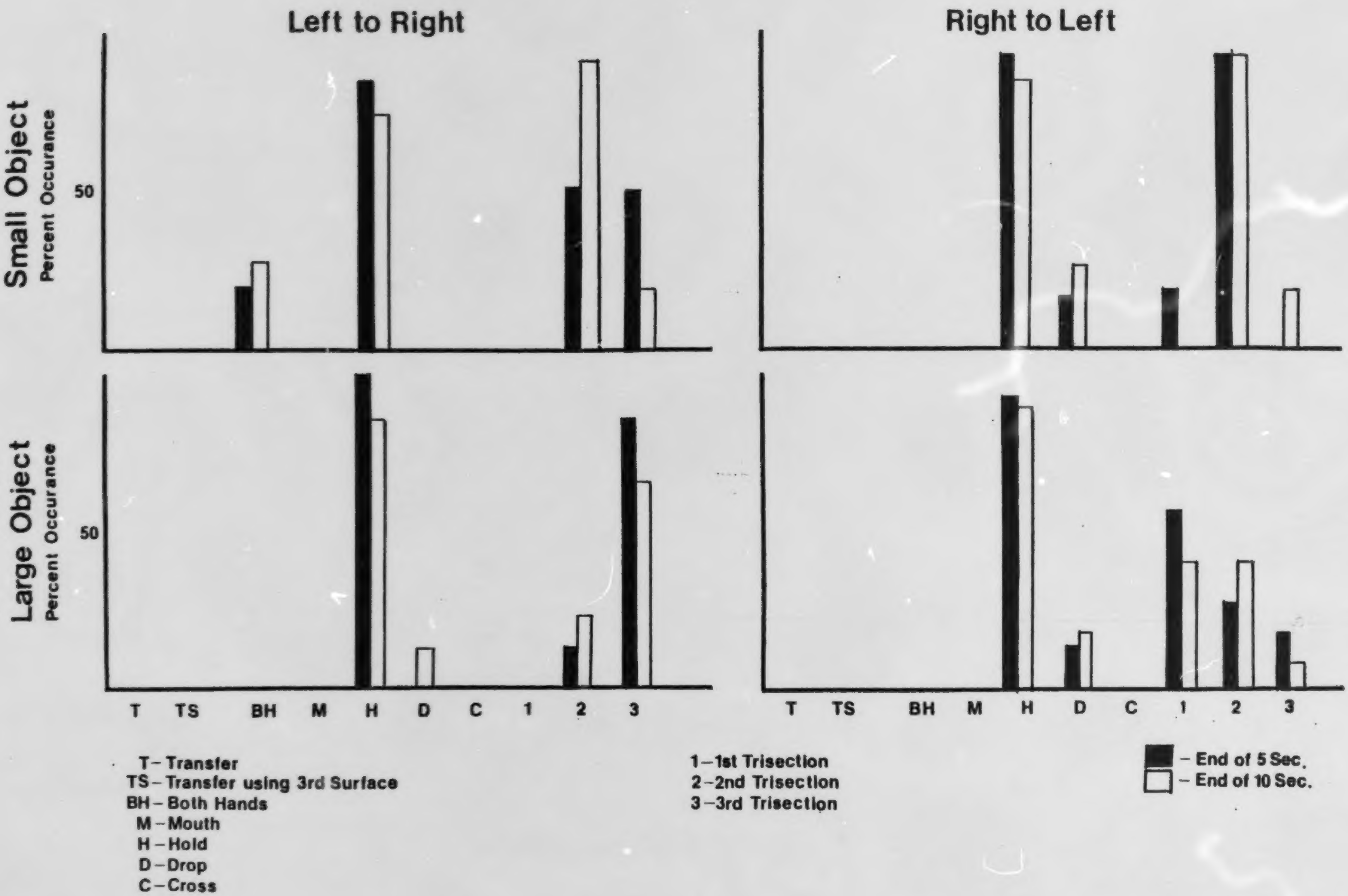


Figure 2: Transfer Performance of Subject 2 in Supported Standing

FM(T)16

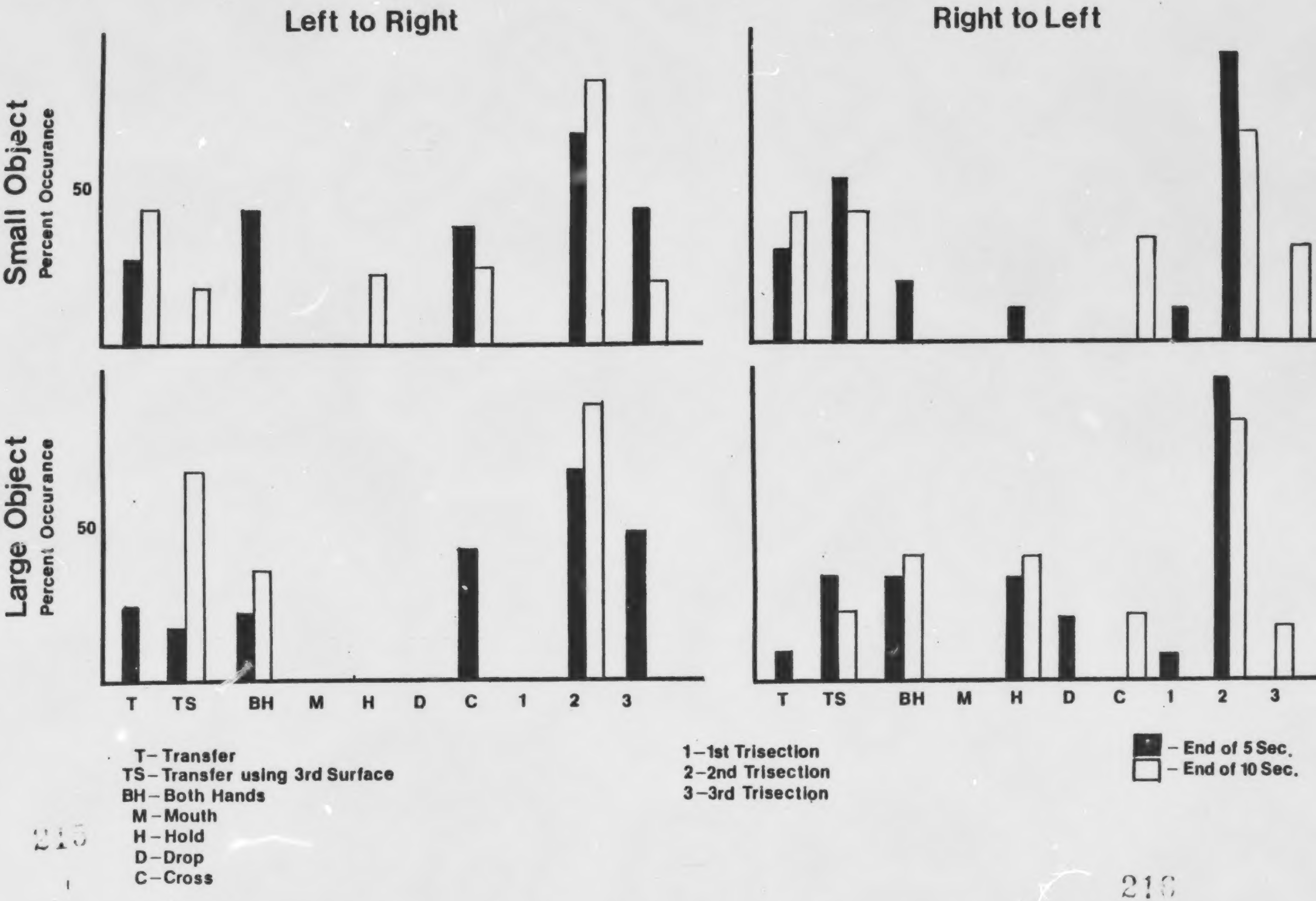
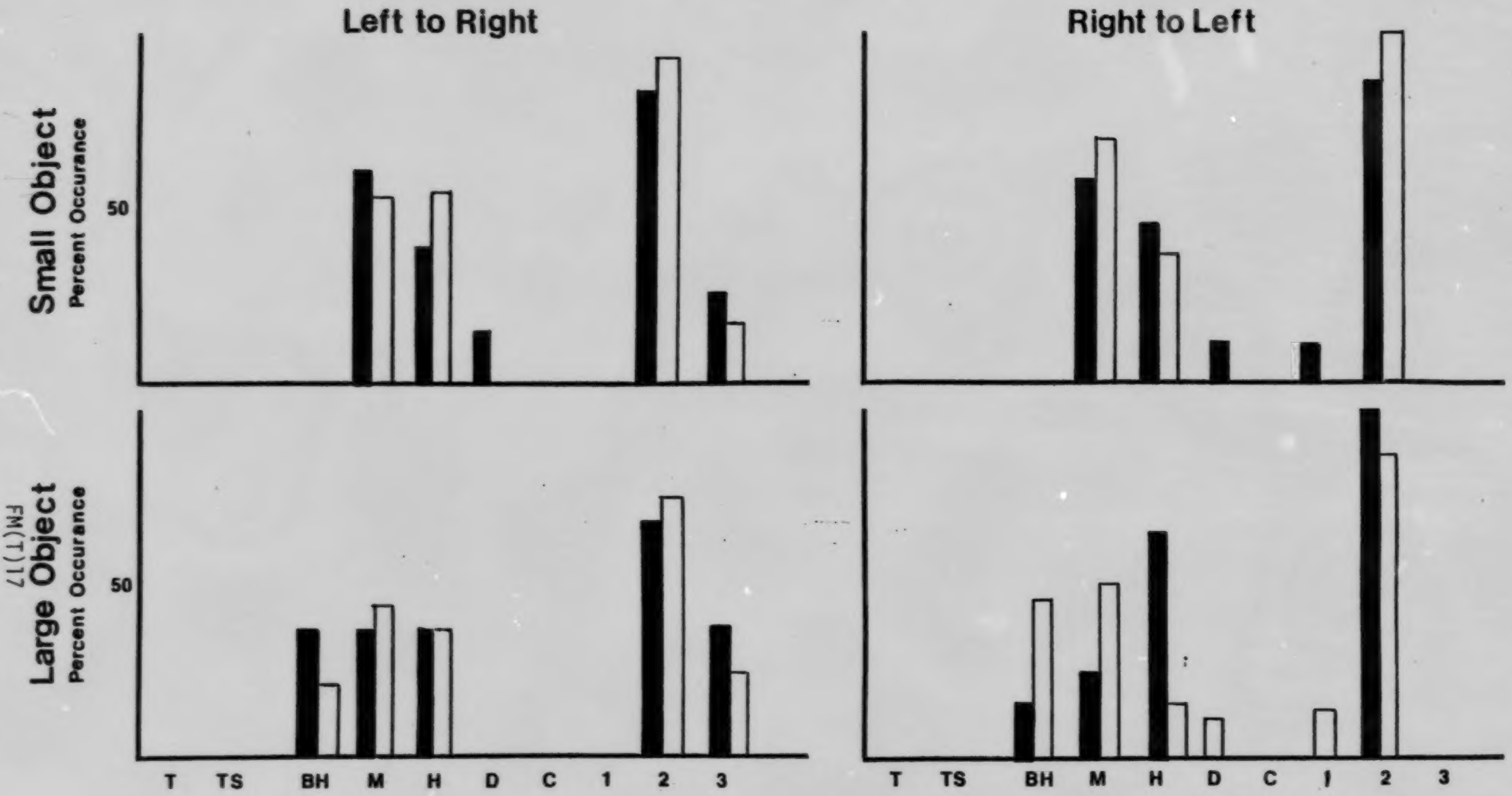


Figure 3: Transfer Performance of Subject 3 in Supported Sitting



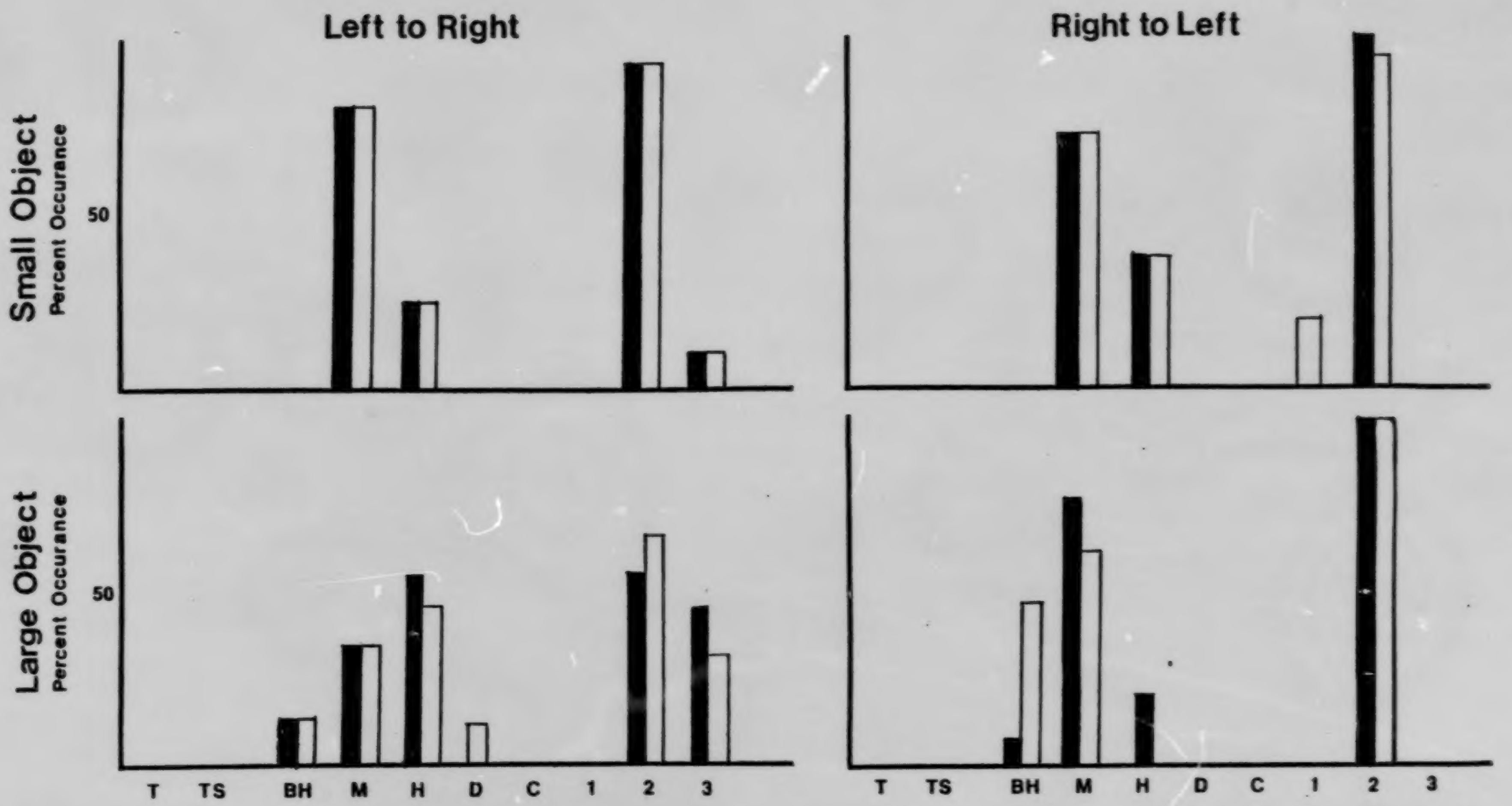
- T–Transfer
- TS–Transfer using 3rd Surface
- BH–Both Hands
- M–Mouth
- H–Hold
- D–Drop
- C–Cross

- 1–1st Trisection
- 2–2nd Trisection
- 3–3rd Trisection

- ■ – End of 5 Sec.
- □ – End of 10 Sec.

Figure 4: Transfer Performance of Subject 4 in Supported Sitting

FM(T)17



T – Transfer
TS – Transfer using 3rd Surface
BH – Both Hands
M – Mouth
H – Hold
D – Drop
C – Cross

1 – 1st Trisection
2 – 2nd Trisection
3 – 3rd Trisection

■ – End of 5 Sec.
☐ – End of 10 Sec.

Figure 5: Transfer Performance of Subject 5 in Supine

FM(T)18

was presented on her right side than when it was presented on her left side. She also transferred a smaller object 33% more often than a large object. When an object was presented on her left side, she always held it in trisections 2 or 3 (middle and left) at the end of the 5 and 10 second periods. When an object was presented to the right side, she always held it in trisections 1 or 2 (middle or right) at the end of the 5 and 10 second periods.

Subject 2 (Joy).

Supported Standing: Figure 2 presents the transfer performance data of Subject 2 in the supported standing position. Joy held the object for 67% to 100% of the trials or for a mean of 83% of the trials. The next most commonly occuring response was a drop, this ranged from 8% to 27% of the responses. Joy performed best with a small object presented on her left side, with this presentation she was able to contact both hands on the object at least 25% of the time. When an object was presented on her left side, she always held it in trisceiton 2 or 3 (middle or left) at the end of the 5 and 10 second periods. She generally, 17% to 83% of responses, held the object in trisections 1 or 2 (right and middle) when an object was presented on the right side. She occasionally, 9% to 18% of responses, held it in trisection 3 (left side).

Subject 3 (Michael).

Supported Sitting: Figure 3 presents the transfer performance data of Subject 3 in the supported sitting position. Michael generally either transferred the object, 8% to 40% of the responses, sometimes using an intermediary surface, 27% to 67% of the responses, or held both hands on the object irrespective of stimulus size or side of presentation. He had greater success in transferring the object when it was presented to his left side. Michael had the greatest difficulty when a large object was presented on his right side, as evidenced by only 8% of the transfer responses and a variety of lower skill level responses, i.e. hold, 25% to 33% of the responses and drop, 17% of the reponses. Almost all responses occured in trisection 2, with a range of 50% to 100% of the responses. All left side presentation responses occurred in trisections 2 and 3 (middle and left), but some right side presentation responses, 17% to 33%, did occur in trisection 3 (left).

Subject 4 (Ricci).

Supported sitting: Figure 4 presents the transfer performance data of Subject 4 in a supported sitting position. Ricci never transfered the object. He performed better with a large object with the both hand responses ranging from 17% to 33% of the time. Ricci generally either mouthed the object 33% to 64% of the response, or held the object, 17% to 58% of the responses. These responses most frequently occurred in trisection 2, 67% to 100% of the time. When the object was presented on the left side, he was scored 17% to 33% of the time in trisection 3 (left side) and when the object was presented on his right side, he was scored 3% to 17% of the time in trisection 1 (right side).

Supine: Figure 5 presents the transfer performance data for Subject 4 in the supine position. Ricci again performed better with a large object, he held it with both hands for 8% to 42% of the responses. Ricci never transfered the object. He generally either mouthed the object, with the response ranging for 33% to 75% of the time, or held the object, with scores ranging from 17% to 50% of the time, across side presentation and stimulus size. Ricci almost always, 58% to 100% of the responses, had the object in trisection 2 when scoring occurred.

Discussion

A discussion of the results of this study include a brief presentation of overall reliabilities, an analysis of the performance data, and suggestions and implication for future research.

Reliability Measures

The procedures used in this study did provide a reliable and quantitative measurement of transfer skills. The overall interobserver reliability for each child in each position ranged from 88% to 96%. This indicates a highly reliable measurement procedure. The procedures was most reliable on Subject 4, an athetoid quadraplegic with very limited motoric responses. Subject 4 rarely moved the object, except to the mouth, which made the responses easy to observe. In three of the five subject positions, the transfer code yielded a higher reliability than the position code. This was probably due to the difficulty in assessing the accurate trisection number when the subject held the object on the line between the two trisections.

Performance Measures

Following is a description of the subjects' performance and its relationship to their actual performance in the classroom.

Subject 1, a normal developing six month old was just beginning to transfer in a free play situation. Transfer responses observed during assessment ranged from 8% to 25%. This could be considered indicative of emerging transfer skills. When viewing the performance of Subject

1, a wide variety of transfer responses are noted ranging from what is considered to be the lowest developmental skill to the highest developmental skill. This was not true with most of the handicapped subjects. These students had a limited repertoire of transfer responses, with the exception of Subject 3, a higher functioning motorically involved student.

Subject 2 had a left hemiparesis which was identified during assessment both on the trisection and transfer response scores. When a small object was placed in the left hand, the child brought the right hand to the object. The object was never moved from the left hand into the right trisection. This accurately reflects the manipulation skills of Subject 2, the left side rarely actively moved. An object was never moved from the right hand to the left hand, the subject did move the right hand across midline to the left trisection when holding the object.

Subject 3, diagnosed as having spastic quadraparesis, also demonstrated more spasticity of the left side. This subject was the only one to cross over with the opposite hand in order to attain the second object. This was done much more often when an object was placed in the left hand. The position code profile for left to right responses was similar to Subject 2's. Subject 3 never moved an object to the right trisection when it was placed in the left hand even though objects were transferred left to right. The right hand was always brought to or across midline to the left hand in order to attain the object.

All objects given to Subject 4, or within reach in a free play situation, were mouthed. Objects were also most often mouthed in a structured situation. when an object was placed in the left hand, it was never moved across midline to the right trisection. This was also true when an object was placed in the right hand. Subject 4 also achieved higher level transfer responses in a supported sitting position with a large object, regardless of side presentation. Subject 4 took objects to the mouth less frequently when in a sitting position, therefore this position could be used to decrease mouthing of objects and encourage midline skills.

The major problems encountered with the procedures centered around attempting to elicit the transfer response. Transfer is not an automatic response for most individuals. The two procedures used to elicit the transfer response did elicit the transfer some of the time for each of the subjects, but were not effective all of the time. This was a continuing problem throughout the testing. Attempts were made to use both of the procedures with all of the subjects, although during the actual assessment most subjects' performance was superior with one or the other of the two procedures.

Suggestions and Implications for Further Research

There are several implications for use of this instrument. The procedures could be combined with other measures of fine motor skills for a more comprehensive assessment of a student. This assessment would pinpoint areas to be programmed for and provide information on the arrangement of the classroom environment to better facilitate the transfer response. This assessment could also potentially be used before and after intervention in order to effectively assess and plan programming for student.

Several recommendations for further research can be made. A larger number of subjects, including those with visual and hearing impairments, should be assessed as well as a larger group of normal subjects. Longitudinal research should be conducted in order to verify a developmental sequence of skills and to demonstrate performance growth of subjects. This research could also contribute to and determine the effectiveness of this assessment for monitoring small changes in transfer skills in order to modify intervention procedures.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE RELEASE BEHAVIORS AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with One Nonhandicapped Infant and Four Handicapped Preschoolers[1]

by

Aileen Cronan

and

Marilyn Mulligan

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[1] The procedures and data reported in this study were taken from a Master's thesis by Aileen Cronan submitted to the Department of Special Education at the University of Kansas, July, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages FM(RL) 1 to FM(RL) 22 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures were developed to measure all the parameters involved in a controlled release. They were demonstrated on children in three different body positions: sitting and supported sitting, right and left sidelying, and standing. Measures were taken on the topography of the release response across four different stimulus objects in each measurement session.

The behaviors measured in the topography of the release response were: use of the right or left hand, the digits used, whether the wrist was in the middle, supine or prone position, whether the palm or tips of the hand were involved, if the arm was supported, if resistence against a receiving surface was used during the release, and if the release reflected an accurate response. These responses were observed across four different stimulus objects for each session. These materials included a rod, ball, cube, and pellet. A session included twelve trails, three trials per stimulus item, with the child in one body position. Each child was observed in one or two of his/her most functional body positions across four observation sessions.

The procedures involved a series of activities to draw the child's attention to the stimulus object inorder to elicit a voluntary grasp. If the child did not grasp the object, it was presented towards his/her midline or placed in the child's dominant hand. A release was precipitated by requesting that the child put the stimulus object in a container or give it to the examiner. Instructions, such as prompts and verbalization, were specified in the Procedure. If the child required support at the forearm it was supplied by either resting in the arm on the surface or by the experimenter lifting the arm at a point inbetween the wrist and the elbow. The child had thirty seconds in which to respond. The release responses were scored on the data sheet (Figure 1). If, at the end of thirty seconds the child had not released the object, a "No Release" was scored for that trial.

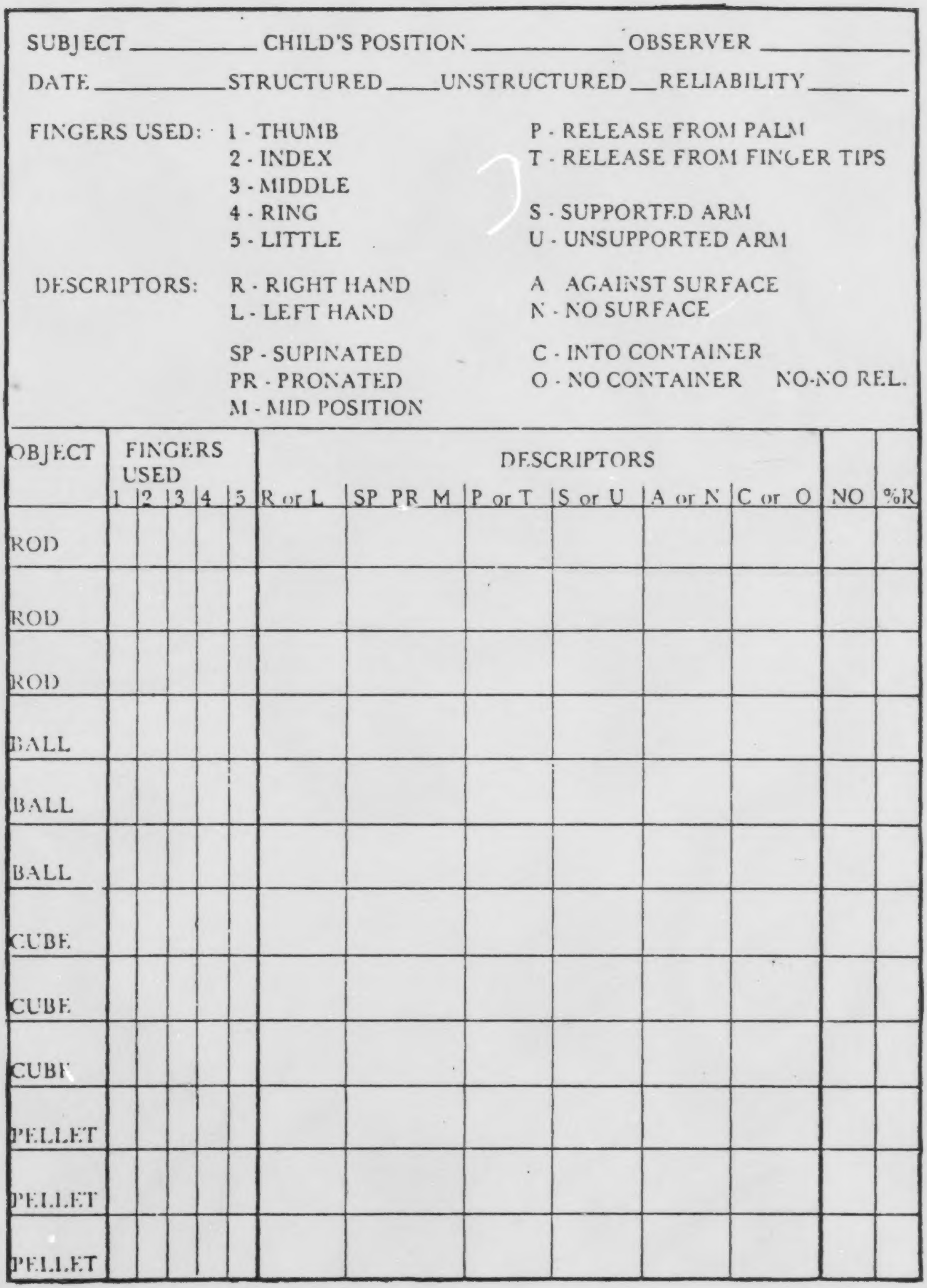
Subjects

Three students from the Preschool for the Severely Multiply Handicapped located at the Kansas University Medical Center were included in this study as well as one normally developing infant.

Subject 1. Jackson was a three year old hypotonic male with a diagnosis of severe developmental delay. He scored at the six month level on the motor development section of the Callier-Azusa Scale (Stillman, 1978). He was able to sit independently when positioned in a chair at a table and could reach a grasp with each hand. He had good head control in sitting but did not roll over or come to a sit independently.

Subject 2. Collette was a four year old female with cerebral hypoplasia, microcephaly, spastic quadriparesis, and seizure disorders. She scored at the twelve month developmental level on the motor development section of the Callier-Azusa Scale. She was able to walk independently and to sit independently in a chair at a table. She reached and grasped objects with each hand.

Subject 3. Martin was a four year old male with a diagnosis of spastic quadriparesis, microcephaly, congenital cleft palate, seizure disorders, and severe developmental delay. On the motor development



SUBJECT __________ CHILD'S POSITION ____________ OBSERVER ____________

DATE __________ STRUCTURED ____ UNSTRUCTURED ___ RELIABILITY ________

FINGERS USED:
- 1 - THUMB
- 2 - INDEX
- 3 - MIDDLE
- 4 - RING
- 5 - LITTLE

- P - RELEASE FROM PALM
- T - RELEASE FROM FINGER TIPS

- S - SUPPORTED ARM
- U - UNSUPPORTED ARM

DESCRIPTORS:
- R - RIGHT HAND
- L - LEFT HAND

- SP - SUPINATED
- PR - PRONATED
- M - MID POSITION

- A AGAINST SURFACE
- N - NO SURFACE

- C - INTO CONTAINER
- O - NO CONTAINER

NO-NO REL.

OBJECT	FINGERS USED					DESCRIPTORS						NO	%R
	1	2	3	4	5	R or L	SP PR M	P or T	S or U	A or N	C or O		
ROD													
ROD													
ROD													
BALL													
BALL													
BALL													
CUBE													
CUBE													
CUBE													
PELLET													
PELLET													
PELLET													

Figure 1. Data sheet for the measurement of release.

section of the Callier-Azusa Scale he scored at the zero to one month level. Martin was unable to reach. Since he had better function with his left hand, test materials were placed in his left hand.

Subject 4. Tim was a normally developing eleven month old male.

Procedures for Obtaining Measures of Reliability

Reliability data were obtained across two observers for each of the three handicapped children in two positions appropriate for the child. These positions included sidelying, sitting, and standing. The non-handicapped child was observed only in supported sitting.

Observers participating in reliability measurements on all the children included a Master's level teacher of the severely multiply handicapped, a physical therapist, a doctoral student in Special Education, a parent, a secretary, a Freshman in college, and the investigator. Each of two consequtive session were observed by the same reliability observer for the same body position.

The investigator always served as the first observer and implemented the procedures. The second observer independently recorded data for each evaluation session. Agreement between the investigator and the second observer were compared. The number of agreements and disagreements between the two observers were recorded for each trial. The number of agreements was divided by the number of agreements plus the number of disagreements and multiplied by 100 to obtain the reliability score for each trail. The sum of the reliability scores for each trial in each session was summed and divided by the total number of trials to calculate the overall reliability for each session. Overall reliability scores from each session were summed and divided by the total number of sessions

(4) to obtain the grand mean reliability across all sessions for each position.

Results

Table 1 presents reliability scores for individual sessions in each position and the mean reliability score for each position across all four sessions. Mean reliabilities range from a low of 88% for Subject 2 in supported sitting to a high of 100% for Subject 3 in right sidelying.

Tables 2 through 5 present reliability scores for each material and descriptor for each child in two positions across four sessions. Figure 2 contains definitions of the code used in these tables. On each table, mean reliabilities for materials across descriptors appear in the last column to the right. Mean reliabilities for descriptors across materials appear in the last row for each Position presented. The grand mean reliability for all descriptors and materials appears in the small box at the lower right hand corner of the table for each position. Mean reliabilities for descriptors across positions and materials appear as the last row of each table. Scores were computed to one decimal place and rounded off to the nearest whole number.

Descriptions of reliability for each subject and position are presented below.

Subject 1 (Jackson)

Table 2 presents reliability scores for the measure of release in right sidelying and supported sitting for Subject 1.

Sidelying Position. Reliabilities for individual descriptors and materials ranged from 50% to 100%. Mean reliabilities for descriptors across materials ranged from 77% to 100%. Mean reliability for materials across descriptors ranged from 91% to 96%. The grand mean was 93%.

Table 1

Overall Reliability Scores

Subject	Position	Reliability Scores per Session	Mean Reliability Score
1	Right Sidelying	92	92
		96	
		86	
		93	
1	Supported Sitting	92	93
		92	
		94	
		94	
2	Standing	91	93
		95	
		92	
		94	
2	Supported Sitting	87	88
		91	
		86	
		87	
3	Right Sidelying	98	98
		96	
		98	
		100	
3	Supported Sitting	94	94
		88	
		95	
		97	
4	Independent Sitting	95	96
		97	
		96	
		97	

Release Occurs. Refers to whether the subject released the object.

Digits involved.
1 - Thumb
2 - Index
3 - Middle
4 - Ring
5 - Little

Left, Rt. - Refers to whether the subject used the right or left hand for release.

Supine, Prone Mid. Refers to the position of the hand at the moment of release.

Palms, Tips. Refers to whether the release was from the palm or the finger tips.

Support Forearm. Refers to whether the forearm was supported.

Against Surface. Refers to whether the release was made against the resisting surface.

Container. Refers to whether the release was made into a container.

Average Reliab. for Materials Across Descriptors. Refers to the average reliability across all descriptors for each material.

Av. Rel. for Descr. Across Materials. Refers to the average reliability across materials for all descriptors.

Grand Average. Average of all reliability scores across all materials and descriptors.

Reliab. Across Positions. Average of reliability for both positions.

Figure 2. Definitions for Code used in Tables 2 through 5.

FM(RL)9

TABLE 2

Reliability Scores Across Materials, Descriptors and Positions for Subject 1

POSITION: Right Sidelying

MATERIAL		DIGITS INVOLVED					DESCRIPTORS						
	RELEASE OCCURS	1	2	3	4	5	LEFT RT:	SUPINE PRONE MID	PALMS TIPS	SUPPORT FOREARM	AGAINST SURFACE	CONTAINER	AVERAGE RELIAB. FOR MATERIALS ACROSS DESCR.
ROD	100	92	92	100	83	50	100	100	92	92	83	100	90
BALL	100	92	100	100	100	100	100	100	100	67	92	100	96
CUBE	100	100	100	100	83	67	100	100	92	100	75	100	93
PELLET	100	100	100	83	100	100	100	100	75	50	83	100	91
AV. REL. FOR DESCR. ACROSS MATERIALS	100	96	98	96	92	79	100	100	90	77	83	100	Grand Average 93
POSITION: Supported Sitting													
ROD	100	67	100	100	83	67	100	92	92	100	83	100	90
BALL	100	75	92	100	100	92	100	100	100	100	83	100	95
CUBE	100	100	92	100	83	92	100	92	92	100	83	100	95
PELLET	100	100	92	100	100	100	100	90	94	96	81	100	93
AV. REL. FOR DESCR. ACROSS MATERIAL	100	86	94	100	92	88	100	90	94	96	81	100	Grand Average 93
RELIAB. ACROSS POSITIONS	100	91	96	98	92	84	100	95	92	87	82	100	93

Supported Sitting. Reliabilities for individual descriptors and materials ranged from 67% to 100%. Mean reliabilities for descriptors across materials ranged from 81% to 100%. Mean reliabilities for materials across descriptors ranged from 90% to 95%. The grand mean was 93%.

Across Positions. Reliabilities across positions ranged form 82% to 100% with a mean of 93%.

Subject 2 (Colette)

Table 3 presents reliabilities scores for the measure of release in independent standing and supported sitting for Subject 2.

Independent Standing Position. Reliabilities for individual descriptors and materials ranged from 67% to 100%. Mean reliabilities for descriptors across materials ranged from 81% to 100%. Mean reliabilities for materials across descriptors ranged from 91% to 95%. The grand mean was 93%.

Supported Sitting Position. Reliabilities for individual descriptors and materials ranged from 33% to 100%. Mean reliabilities for descriptors across materials ranged from 67% to 100%. Average reliabilities for materials across descriptors ranged from 85% to 93%. The grand mean was 88%.

Across Positions. Reliabilities across positions for Subject 2 ranged from 74% to 100% with a grand mean of 91%.

Subject 3 (Martin)

Table 4 presents reliability scores for the measure of release in right sidelying and supported sitting for Subject 3.

Sidelying Position. Reliabilities for individual descriptors and materials ranged from 60% to 100%. Mean reliabilities for descriptors across materials ranged from 82% to 100%. Mean reliabilities

TABLE 3

Reliability Scores Across Materials,
Descriptors and Positions
for Subject 2

MATERIAL		DIGITS INVOLVED					DESCRIPTORS						
	RELEASE OCCURS	1	2	3	4	5	LEFT RT.	SUPINE PRONE MID	PALMS TIPS	SUPPORT FOREARM	AGAINST SURFACE	CONTAINER	AVERAGE RELIAB. FOR MATERIALS ACROSS DESCR
POSITION: Independent Standing													
ROD	100	83	100	100	100	92	100	75	100	100	75	100	94
BALL	100	100	100	100	67	58	100	92	75	100	100	100	91
CUBE	100	92	100	100	83	75	100	83	92	100	92	100	93
PELLET	100	100	100	92	92	100	100	75	83	100	92	100	95
AV. REL. FOR DESCR. ACROSS MATERIALS	100	94	100	98	86	81	100	81	88	100	90	100	GRAND AVERAGE 93
POSITION: Supported Sitting													
ROD	100	83	100	100	100	100	100	75	100	75	83	100	93
BALL	100	100	92	92	83	75	100	83	67	33	92	100	85
CUBE	100	100	100	100	58	17	100	92	100	92	92	100	88
PELLET	100	92	92	92	83	75	100	58	83	67	92	100	86
AV. REL. FOR DESCR. ACROSS MATERIALS	100	94	96	96	81	67	100	77	88	67	90	100	GRAND AVERAGE 88
RELIAB. ACROSS POSITIONS	100	94	98	97	84	74	100	79	88	84	90	100	91

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TABLE 4

Reliability Scores Across Materials, Descriptors and Positions for Subject 3

POSITION: Right Sidelying

MATERIAL		DIGITS INVOLVED					DESCRIPTORS						
	RELEASE OCCURS	1	2	3	4	5		SUPINE PRONE MID	PALMS TIPS	SUPPORT FOREARM	AGAINST SURFACE		AVERAGE RELIAB. FOR MATERIALS ACROSS DESCR.
ROD	100	100	100	100	100	67		100	100	100	100	Use of container inappropriate for Subject 3	97
BALL	100	80	100	100	100	60		80	100	100	80		90
CUBE	100	100	89	100	100	100		100	100	100	100		99
PELLET	100	89	100	100	100	100		100	100	89	89		97
AV. REL. FOR DESCR. ACROSS MATERIALS	100	92	97	100	100	82		95	100	97	92		GRAND AVERAGE 96
POSITION: Supported Sitting													
ROD	100	100	100	100	100	100		100	100	100	33	Use of container inappropriate for Subjcet 3	93
BALL	100	71	86	100	100	71		100	100	100	100		93
CUBE	100	100	90	90	100	90		100	100	100	80		95
PELLET	100	75	58	100	92	92		100	83	75	75		85
AV. REL. FOR DESCR. ACROSS MATERIALS	100	87	84	98	98	88		100	96	94	72		GRAND AVERAGE 92
RELIAB. ACROSS POSITIONS	100	90	91	99	99	85		98	98	96	82		94

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for materials across descriptors ranged from 90% to 97%. The grand mean was 96%.

Supported Sitting Position. Reliabilities for individual descriptors and materials ranged from 33% to 100%. Mean reliabilities for descriptors across materials ranged from 72% to 100%. Mean reliabilities for materials across descriptors ranged from 85% to 95%. The grand mean was 92%.

Across Positions. Reliabilities across positions for Subject 3 ranged from 82% to 100% with a grant mean score of 94%.

Subject 4 (Tim)

Table 5 presents reliability scores for the measure of release in independent sitting for Subject 4.

Independent Sitting Position. Reliabilities for individual descriptors and materials ranged from 75% to 100%. Mean reliabilities for descriptors across materials ranged from 83% to 100%. Mean reliabilities for materials across descriptors ranged from 95% to 97%. The grand mean was 96%.

Performance Data on Release Responses

The performance for each child is presented as percent data on bar graphs in Figures 4 through 10. Coded descriptors of the preferred behaviors appear in Figure 3. They include occurrence of release, part of hand used, position of arm, amount of support, and degree of control. These descriptors were selected for graphing because they represent the components of a controlled, well developed release. Separate graphs are used for the left and right hand, for each type of material used and for each separate body position. Tables 6 through 18 in Appendix A present actual percent scores.

TABLE 5

Reliability Scores Across Materials, Descriptors and Positions for Subject 4 (Non-Handicapped)

POSITION: Independent Sitting

MA TERIAL		DIGITS INVOLVED					DESCRIPTORS						
	RELEASE OCCURS	1	2	3	4	5	LEFT RT.	SUPINE PRONE MID	PALMS TIPS	SUPPORT FOREARM	AGAINST SURFACE	CONTAINER	AVERAGE RELIAB. FOR MATERIALS ACR. DESCR.
ROD	100	100	100	100	100	100	100	75	100	100	83	100	97
BALL	100	100	100	100	100	100	100	100	92	100	75	100	97
CUBE	100	100	100	100	100	75	100	75	100	100	92	100	95
PELLET	100	100	100	100	100	100	100	83	69	100	100	100	96
AV. REL. FOR DESCR. ACROSS MATERIALS	100	100	100	100	100	94	100	83	90	100	88	100	GRAND AVERAGE 96

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R - Occurrence of a Release

1 - Involvement of Thumb

2 - Involvement of Index Finger

3 - Involvement of Middle Finger

4 - Involvement of Right Finger

5 - Involvement of Little Finger

M - Hand in Mid Position

PR - Hand Pronated

T - Release from Finger Tips

U - Unsupported Arm

N - No Resistance

C - Into Container

Figure 3. Codes for descriptors used in Figures 4 through 10.

Subject 1 (Jackson)

Supported Sitting Position. Figure 4 presents the release responses of Subject 1 in supported sitting position. Performance is separately presented for the left and right hands.

Significant hand dominance did not appear with the rod, ball and cube. Left handed dominance was apparent during release of the pellet. When looking at release with the left hand, release occurred 100% of the time with the pellet but 33% to 58% of the time with the other 3 materials. Jackson used five digits and a palmar release for releasing the rod and ball from 80% to 100% of the time. For release of the cube and pellet a pincer release began to emerge. The first three digits were used 80% to 100% of the time. Finger tips were used in release of the pellet 67% of the time. Release was unsupported 90% to 100% of the time. With the rod and pellet, release was free of a resisting surface from 75% to 86% of the time. With the cube and ball there was no resisting surface from 0% to 29% of the time.

Sidelying Position. Figure 5 presents release responses of Subject 1 in the sidelying position. Left handed dominance was apparent in the release of all materials. Release occurred with the left hand from 83% to 100% of trials. When considering release with the left hand, patterns were similar with the rod, cube, and ball. A palmar release using four digits was used form 80% to 100% of the time. A two digit pincer grasp was used in release of the pellet from 92% to 100% of the time. the arm was pronated during all left handed releases and finger tips were used for the rod, cube, and pellet from 9% to 75% of the time. All releases of the rod and ball were unsupported. Unsupported release

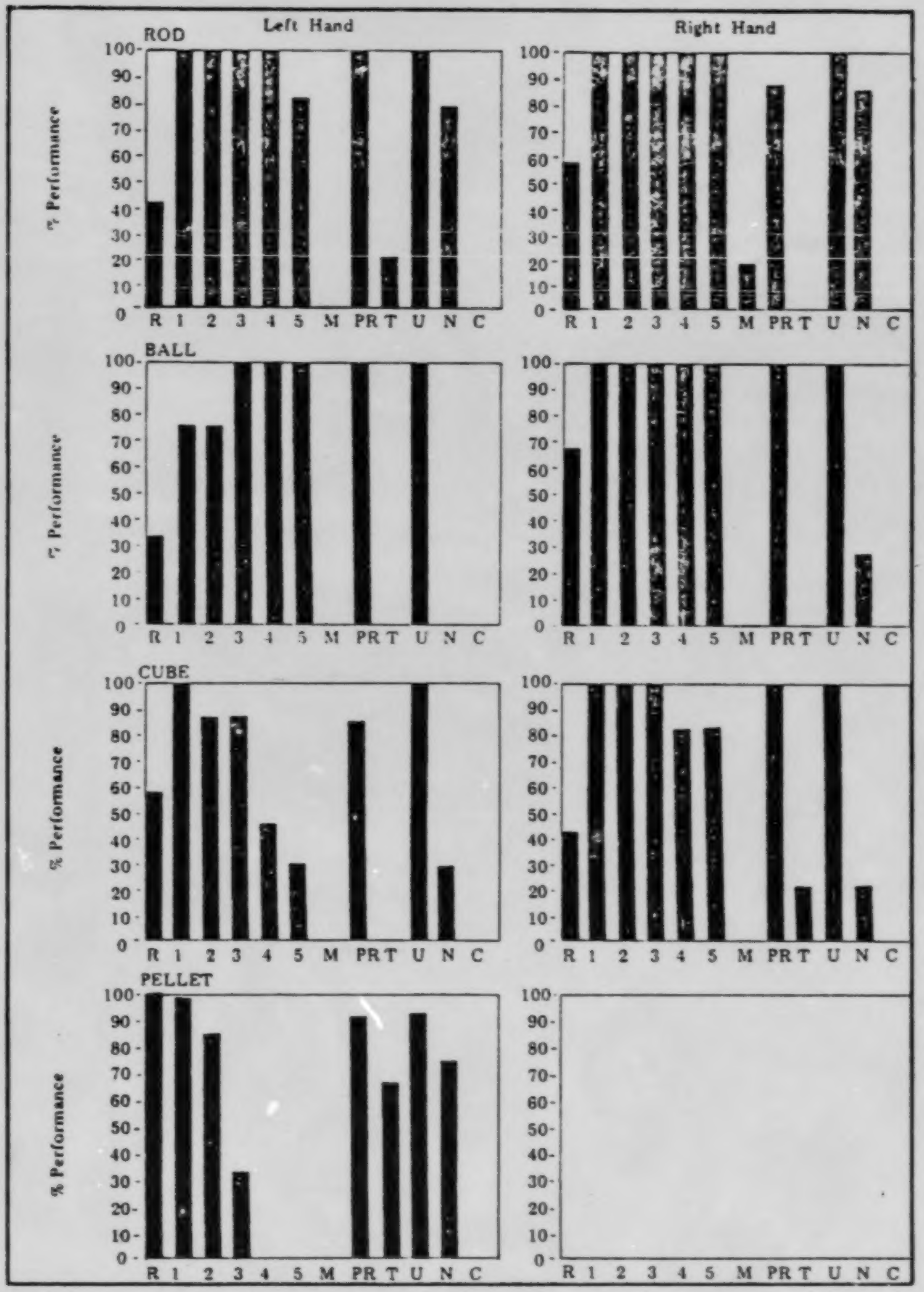

Figure 4. Release responses of Subject 1 in the supported sitting position.

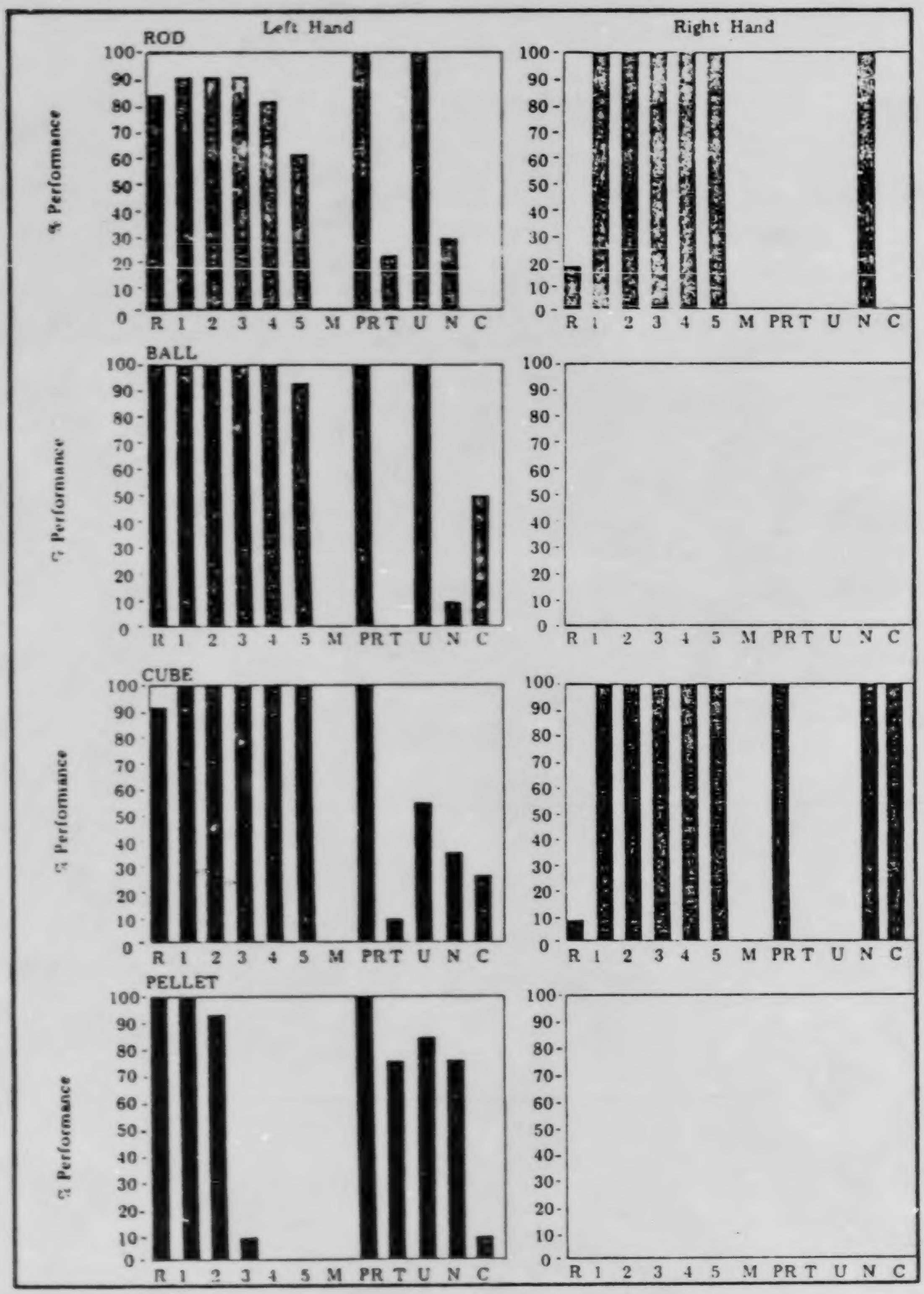

Figure 5. Release responses of Subject 1 in the sidelying position.

of the cube and pellet ranged from 55% to 83%. From 8% to 36% of releases with the rod, cube, and ball were free of a resisting surface. A controlled release into a container appeared 27% of the time with the cube and 50% of the time with the ball.

Subject 2 (Colette)

Supported Sitting Position. Figure 6 presents the release responses of Subject 2 in supported sitting position. Performance is separately presented for the right and left hands.

Right handed dominance was apparent with all materials. When looking at performance with the right hand, release occured 100% of the time with the ball and from 75% of 92% of the time with the cube, pellet, and rod. Colette used five digits and a palmar release for releasing the rod 100% of the time. The fourth and fifth fingers were used from 67% to 91% of the time with the ball and cube. Emergence of a pincer release was apparent with the pellet. The first two digits were used 67% of the time. Finger tips were used in the release of the pellet 64% of the time as compared to from 0% to 33% with the rod, ball and cube. Release was unsupported from 8% to 100% of the time, free of a resisting surface from 18% to 91% of the time, and into a container from 0% to 55% of the time.

Standing Position. Figure 7 represents release responses of Subject 2 in the standing position.

Right handed dominance was apparent in the release of all materials. Release occurred with the right hand from 75% to 100% of the time. When considering release with the right hand, patterns showed a gradual change across materials. A palmar release using all 5 digits was seen with the rod. A pincer release, using only the first two digits and finger

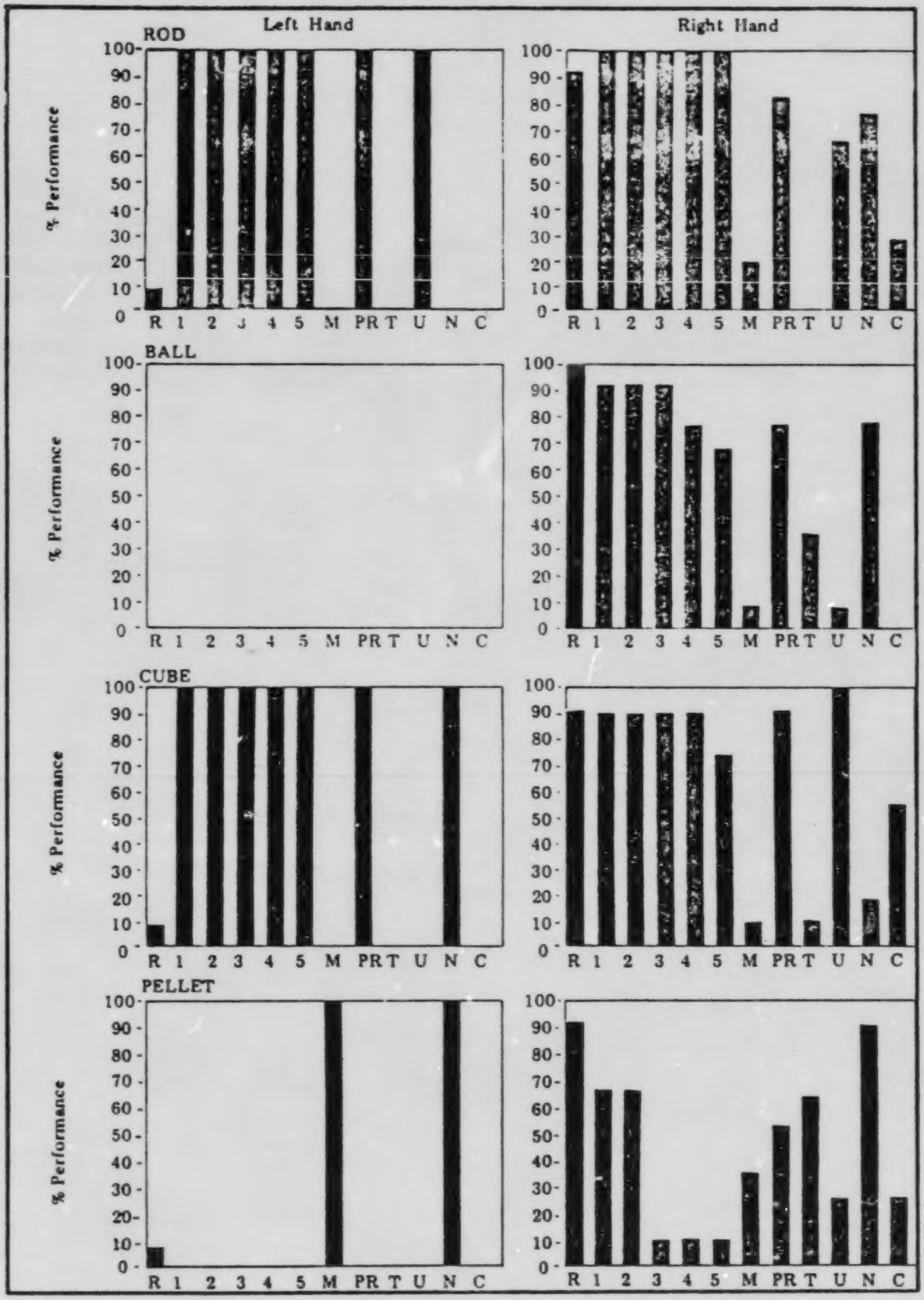

Figure 6. Release responses of Subject 2 in the supported sitting position.

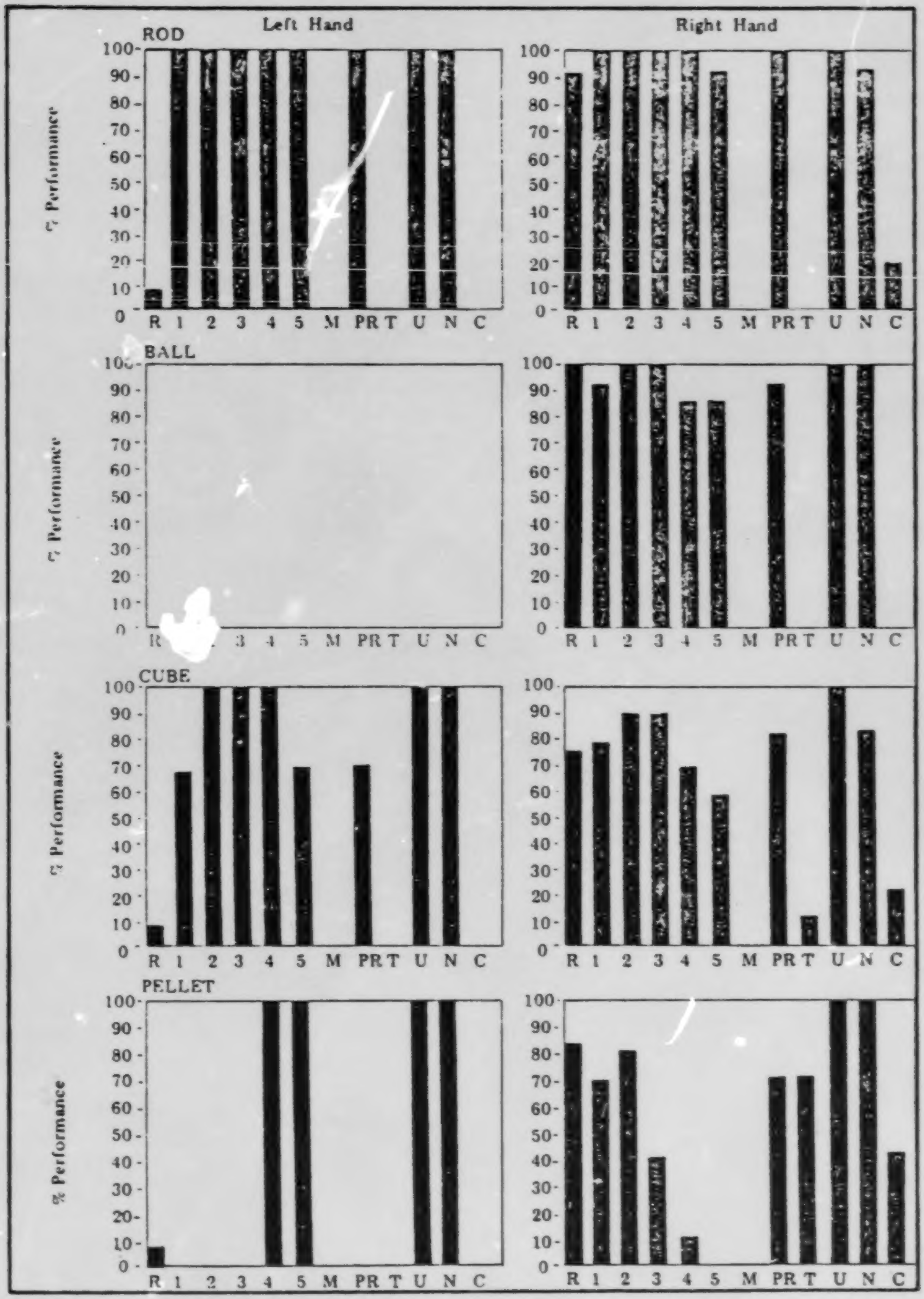

Figure 7. Release responses of Subject 2 in the standing position.

tips, was used in release of the pellet. The palmar release of the rod occurred from 91% to 100% of the time and the pincer release of the pellet occurred from 70% to 80% of the time. Release was unsupported 100% of the time, and was free of a resisting surface from 78% to 100% of the time. Controlled release into a container ranged from 0% with the ball to 40% with the pellet.

Subject 3 (Martin)

Martin did not demonstrate a voluntary reach response, therefore, the use of a container to demonstrate controlled release was deleted from Martin's assessment. Lack of movement in Martin's right hand necessitated placing all objects in Martin's left hand.

Supported Sitting Position. Figure 8 presents the release responses of Subject 3 in supported sitting position.

When looking at release across materials with the left hand, release occurred 100% of the time with the pellet but from 25% to 83% of the time with the other three materials. Release patterns were similar with the rod, ball, and cube. For these objects, a palmar release, using at least four digits, occurred 100% of the time. The arm was pronated during all releases and finger tips were used only when releasing the pellet. Finger tip release of the pellet occurred 17% of the time. Unsupported release of all materials ranged from 33% to 80%. Release was free of a resisting surface from 67% to 75% of the time across all materials.

Sidelying Position. Figure 9 presents release responses of Subject 3 in slidelying position.

Martin showed difficulty releasing the rod and ball then the cube and pellet. Release occurred 25% and 42% of the time with the rod and ball. Release of the cube and pellet occurred 75% of the time. Patterns

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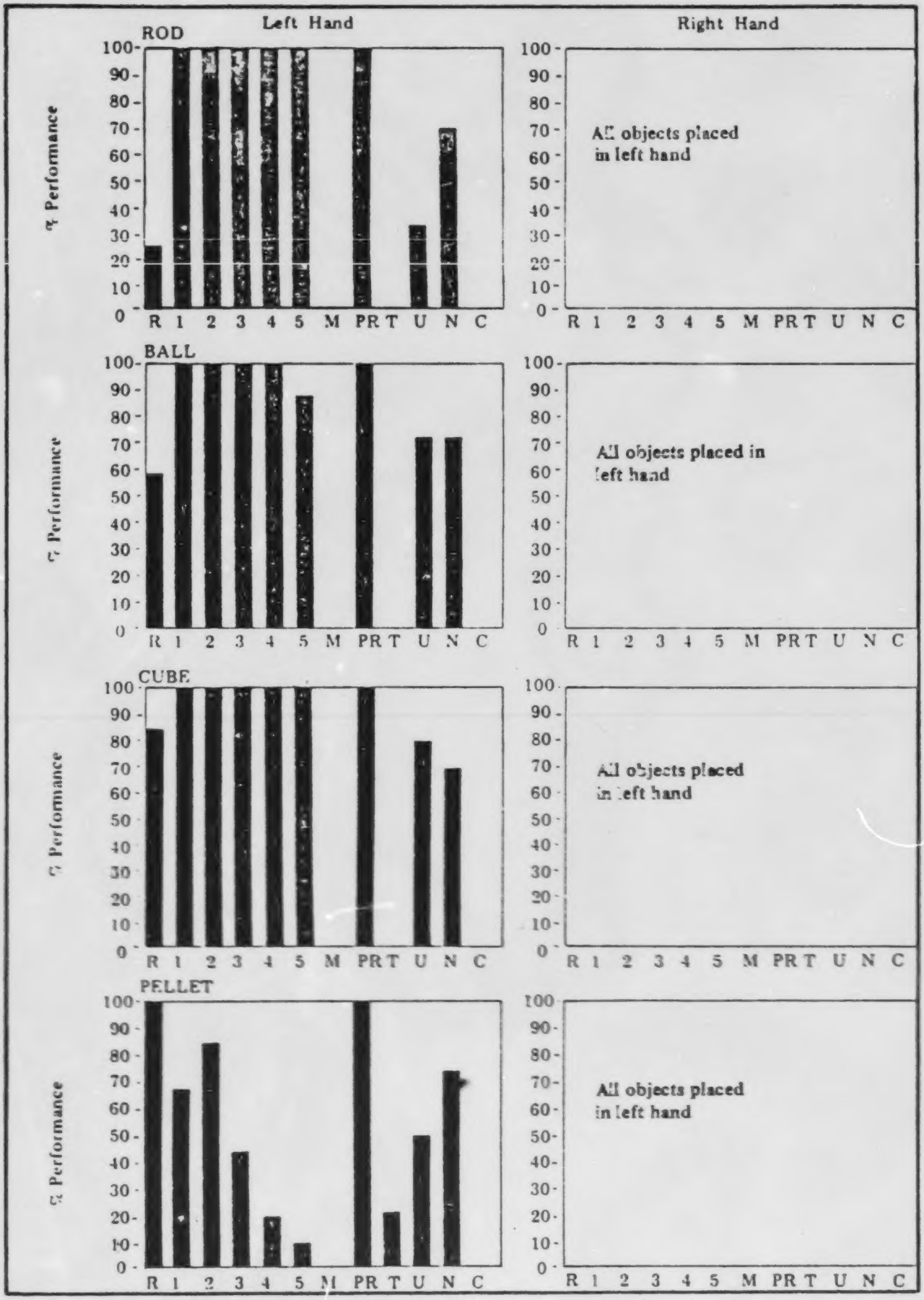

Figure 8. Release responses of Subject 3 in the supported sitting position.

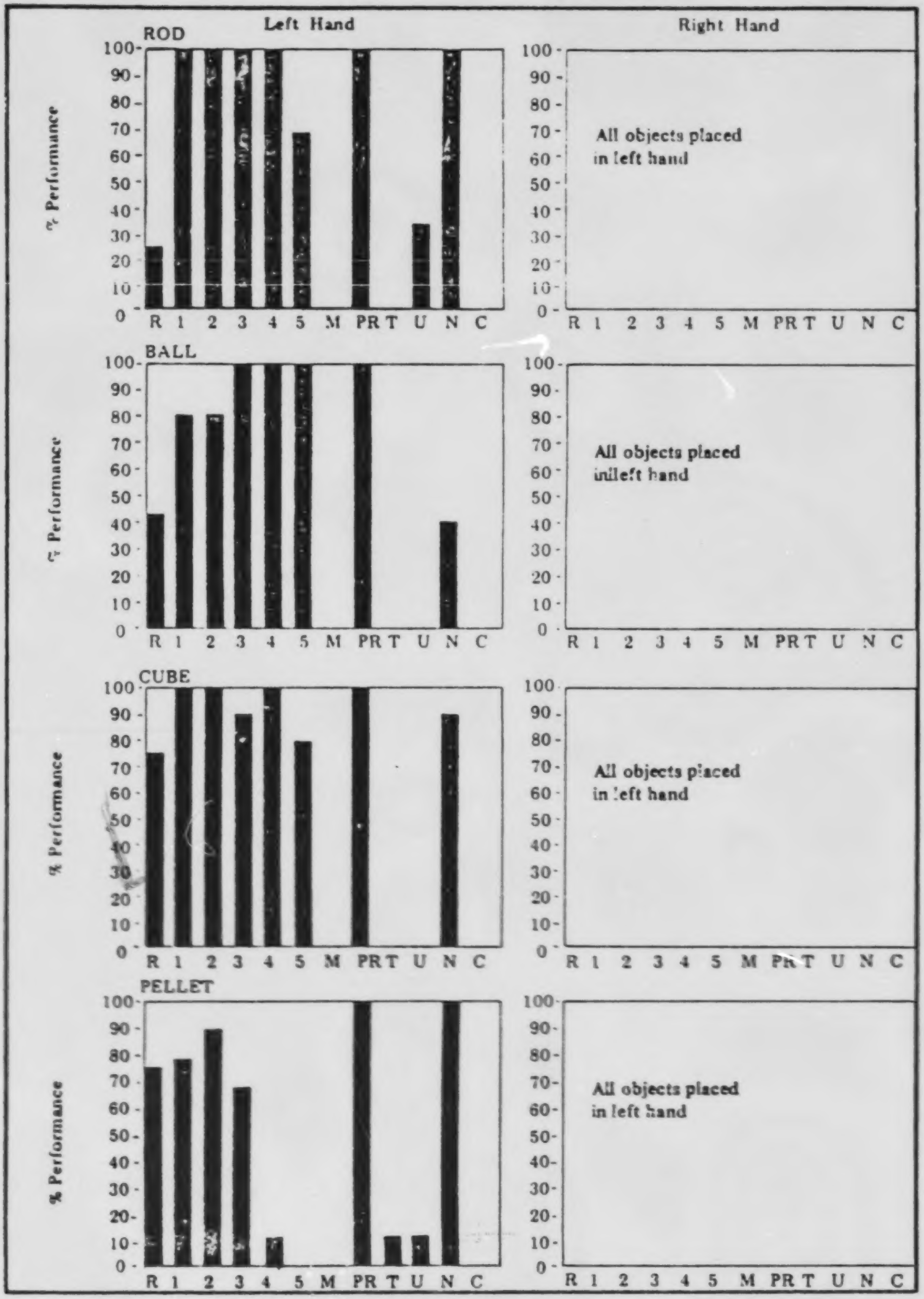

Figure 9. Release responses of Subject 3 in the sidelying position.

of release were similar with the rod, ball, and cube, utilizing a five digit palmar release from 67% to 100% of the time. All releases were pronated and required support. Unsupported release appeared only 11% of the time with the pellet and 33% of the time with the rod. Release was free of a resisting surface from 89% to 100% of the time with the rod, cube and pellet. Martin frequently needed a resisting surface to release the ball. Release of the ball occurred 40% of the time from of a resisting surface. Release patterns with the pellet differed from patterns of release patterns with the other materials. For the pellet, Martin used the first three fingers from 67% to 89% of the time. Involvement of the fourth finger occurred 11% of the time. Use of the finger tips appeared only with the pellet. Tip release of the pelet occurred 8% of the time.

Subject 4 (Tim)

Sitting Position. Figure 10 presents release responses of Subject 4 in sitting position. Performance is separately presented for the left and right hands.

Significant hand dominance was not apparent, therefore release patterns are discussed for both hands at once. Release occurred 100% of the time. Tim released the rod and pellet more often with his right hand, and the ball and cube more often with his left hand. Topography of release was similar for the rod, ball, and cube. For these materials, release involved 5 digits and a pronated palmar grasp from 80% to 100% of the time. All releases were unsupported. Occurance of releases free of a resisting surface and into a container ranged from 0% to 100% for the rod, ball, and cube.

Topography of release of the pellet differed from release of the other materials. The first two fingers were used from 75% to 88% of

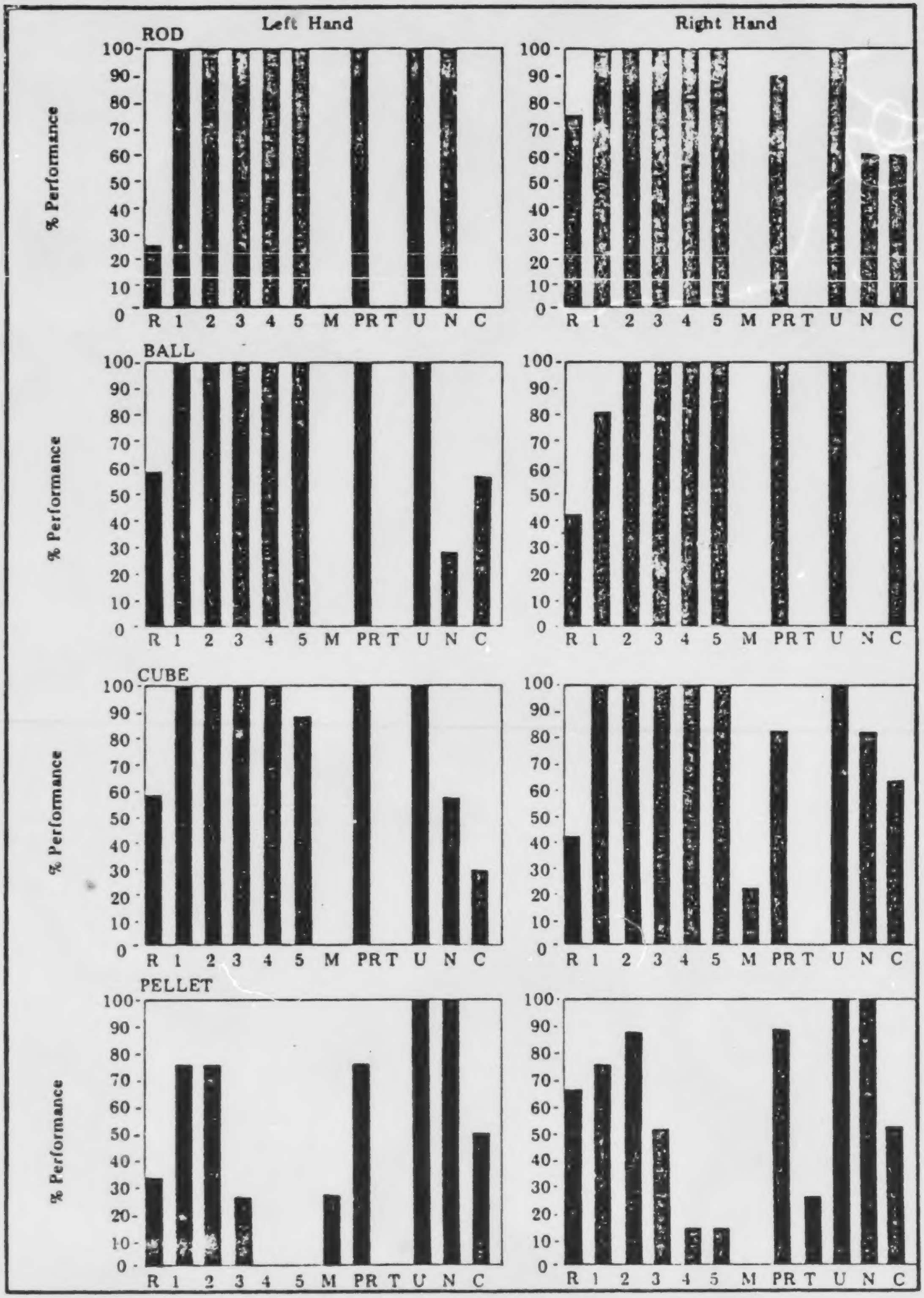

Figure 10. Release responses of Subject 4 in the sitting position.

the time and the third digit was involved from 25% to 50% of the time. The fourth and fifth digits were used from 0% to 13% of the time. All releases were unsupported and free of a resisting surface; 75% to 88% were pronated and 50% were into a container.

Discussion

The primary pupose of this study was to develop a viable means for quantitively measuring the acquisition of the fine motor skill, release. Discussion focuses on reliability, if the data reflect the actual performance of the subjects, and implications and recomendations for further research.

Results from Reliability Measures

Overall mean reliability for all four subjects was 95%. A few scattered low reliability scores appear throughout subjects on individual descriptors. In most instances, these were the result of unclear behavioral definitions. These problems were alleviated once definitions were clarified.

Obtaining reliability for the fifth digit was more difficult than for the other descriptors, particularly for Subjects 1 and 2, Jackson and Colette. Release for these children occurred instantaneously, without forewarning to the observers.

Performance of Subjects

The assessment was of value in pinpointing emerging skills for Subject 1, Jackson. Jackson predominantly used his left hand for release of objects. This probably indicated emerging hand cominance and should be considered when selecting materials and planning programs.

The fact that most of the releases were unsupported suggests that no additional arm support will be needed when planning programs. The data are misleading in showing that the object was released into a container more often in the sidelying position than in supported sitting. One might surmise that sidelying would be a preferable position for programming. Observers commented, however, that random chance seemed to determine placement into the container. The object was placed into the container 1% of the time in standing position and from 0% to 50% in the sidelying position.

Performance of Subject 2 was hampered by other behaviors. Colette frequently engaged in sudden bizarre activities. Right hand dominance and a pincer release were apparent with all materials. Although Collette released the rod, cube, and pellet into the container from 9% to 55% of trials, observers commented that Collette was an extremely distractible child and was rarely looking in the direction of the container at the moment of release. Placement into the container seemed a result of random chance. The data indicates that Collett's performance was slightly better in the standing position. Based on results of this assessment, Collette would be ready for training activities requiring a pincer grasp and these activities possibly would be easier for her in the standing position.

Initial attempts at assessing Martin, Subject 3, indicated the lack of a reaching response. Therefore, the examiner eliminated use of a container for this subject. The data provides information by identifying the lack of movement in Martin's right hand and the fact that less forearm support for Martin was needed for release in the supported sitting position.

The 30 second time limit per trial was inappropriate for Tim, Subject 4, a nonhandicapped infant. Several trials were eliminated because the child became so interested in the objects that the trainer was unable to precipitate a release. Tim placed the objects into a container 50% of the time and demonstrated a pincer release with the pellet from 75% to 88% of the time. Observers agreed that the objects missed the container because Tim seemed to enjoy haphazardly dropping objects. In this case, placement in the container seemed to measure compliance rather than release skill.

Implications and Recommendations for Research

Few available assessments have specifically addressed release as a fine motor skill, yet, release plays an integral part in the development of fine motor skill necessary for functionally manipulating objects. This assessment considers slowly emerging levels of release by operationally defining and tracking the skills as the child matures without assuming a normal developmental progression.

A classroom teacher, using these procedures, can track the emergence of this skill by noting which fingers are used, whether release is from the palms or finger tips, whether the arm is supported or unsupported, and whether the object is released against a resisting surface. This assessment assists the teacher in determining optimal positioning for programs requiring manipulation of objects and also provides the teacher with a measure of fine motor skills without the assumption of a predetermined sequence.

Refinements of these measurement procedures should be used to collect longitudinal data in order to compare similarities and dissimilarities in the development of release skills in handicapped and non-handicapped children and to determine if these procedures are more sensitive to emerging release skills than assessments currently used with this population.

In replicating the study, researchers might consider reducing the time required by evaluating release skills concurrently with reach and grasp assessment. Procedures could be further refined by considering the fourth and fifth fingers as one unit and by developing an operational definition which would be more successful in reflecting the accuracy of the release response.

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APPENDIX A

TABLE 6

Ratio and Percent of Performance of
Release in the Supported Sitting position
Subject 1 with the Left Hand

ROD	5/12 42	5/5 100	5/5 100	5/5 100	5/5 100	4/5 80	0/5 0	5/5 100	1/5 20	5/5 100	4/5 80	0/5 0
BALL	4/12 33	3/4 75	3/4 75	4/4 100	4/4 100	4/4 100	0/4 0	4/4 100	0/4 0	4/4 100	0/4 0	0/4 0
CUBE	7/12 58	7/7 100	6/7 86	6/7 86	3/7 43	2/7 29	0/7 0	6/7 86	0/7 0	7/7 100	2/7 29	0 0
PELLET	12/12 100	11/12 99	10/12 83	4/12 33	0/12 0	0/12 0	0/12 0	11/12 92	8/12 67	11/12 92	9/12 75	0/12 0
	R	1	2	3	4	5	M	PR	T	U	N	C

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

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TABLE 7

Ratio and Percent of Performance of Release
in the Supported Sitting Position
Subject 1 with the Right Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	7/12 58	7/7 100	7/7 100	7/7 100	7/7 100	7/7 100	1/7 14	6/7 86	0/7 0	7/7 100	6/7 86	0/7 0
BALL	8/12 67	8/8 100	8/8 100	8/8 100	8/8 100	8/8 100	0/8 0	8/8 100	0/8 0	8/8 100	2/8 25	0/8 0
CUBE	5/12 42	5/5 100	5/5 100	5/5 100	4/5 80	4/5 80	0/5 0	5/5 100	1/5 20	5/5 100	1/5 20	0/5 0
PELLET	0/12 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

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TABLE 8

Ratio and Percent of Performance in the Sidelying Position Subject 1 with the Left Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	10/12 83	9/10 90	9/10 90	9/10 90	8/10 80	6/10 60	0/10 0	10/10 100	2/10 20	10/10 100	3/10 30	0/10 0
BALL	12/12 100	12/12 100	12/12 100	12/12 100	12/12 100	11/12 92	0/12 0	12/12 100	0/12 0	12/12 100	1/12 8	6/12 50
CUBE	11/12 92	11/11 100	11/11 100	11/11 100	11/11 100	11/11 100	0/11 0	11/11 100	1/11 9	6/11 55	4/11 36	3/11 27
PELLET	12/12 100	12/12 100	11/12 92	1/12 8	0/12 0	0/12 0	0/12 0	12/12 100	9/12 75	10/12 83	9/12 75	1/12 8

__NOTE__ The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

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TABLE 9

Ratio and Percent of Performance of
Release in the Sidelying Position
Subject 1 with the Right Hand

ROD	2/12 17	2/2 100	2/2 100	2/2 100	2/2 100	2/2 100	0/2 0	0/2 0	0/2 0	0/2 0	2/2 100	0/2 0
BALL	0/12 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0
CUBE	1/12 8	1/1 100	1/1 100	1/1 100	1/1 100	1/1 100	0/1 0	1/1 100	0/1 0	0/1 0	1/1 100	1/1 100
PELLET	0/12 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0
	R	1	2	3	4	5	M	PR	T	U	N	C

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 10

Performance of Release in the
Supported Sitting Position
Subject 2 with the left hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	1/12 8	1/1 100	1/1 100	1/1 100	1/1 100	1/1 100	0/1 0	1/1 100	0/1 0	1/1 100	0/1 0	0/1 0
BALL	0/12 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0	0/0 0
CUBE	1/12 8	1/1 100	1/1 100	1/1 100	1/1 100	1/1 100	0/1 0	1/1 100	0/1 0	0/1 0	1/1 100	0/1 0
PELLET	1/12 8	0/1 0	0/1 0	0/1 0	0/1 0	0/1 0	1/1 100	0/1 0	0/1 0	0/1 0	1/1 100	0/1 0

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 11

Performance of Release in the Supported Sitting Position Subject 2 with the Right Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	11/12 92	11/11 100	11/11 100	11/11 100	11/11 100	11/11 100	2/11 18	9/11 82	0/11 0	7/11 64	8/11 73	3/11 27
BALL	12/12 100	11/12 92	11/12 92	11/12 92	9/12 75	8/12 67	1/12 8	9/12 75	4/12 33	1/12 8	9/12 75	0/12 0
CUBE	11/12 92	10/11 91	10/11 91	10/11 91	10/11 91	8/11 73	1/11 9	10/11 91	1/11 9	11/11 100	2/11 18	6/11 55
PELLET	11/12 92	8/11 67	8/11 67	1/11 9	1/11 9	1/11 9	4/11 36	6/11 55	7/11 64	3/11 27	10/11 91	3/11 27

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 12

Performance of Release in the
Standing Position
Subject 2 with the Left Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	1/12 8	1/1 100	1/1 100	1/1 100	1/1 100	1/1 100	0/1 0	1/1 100	0/1 0	1/1 100	1/1 100	0/1 0
BALL	0/12	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
CUBE	3/12 8	2/3 67	3/3 100	3/3 100	3/3 100	2/3 67	0/3 0	2/3 67	0/3 0	3/3 100	3/3 100	0/3 0
PELLET	1/12 0	0/1 0	0/1 0	0/1 0	1/1 100	1/1 100	0/1 0	0/1 0	0/1 0	1/1 100	1/1 100	0/1 0

NOTE. The fraction in theupper portion of each box represents thenumber of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 13

Performance of Release in the Standing Position Subject 2 with the Right Hand

ROD	11/12 92	11/11 100	11/11 100	11/11 100	11/11 100	10/11 91	0/11 0	10/11 91	0/11 0	11/11 100	10/11 91	2/11 18
BALL	12/12 100	11/12 92	12/12 100	12/12 100	10/12 83	10/12 83	0/12 0	11/12 92	0/12 0	12/12 100	12/12 100	0/12 0
CUBE	9/12 75	7/9 78	8/9 89	8/9 89	6/9 67	5/9 56	0/9 0	7/9 78	1/9 11	9/9 100	7/9 78	2/9 22
PELLET	10/12 83	7/10 70	8/10 80	4/10 40	1/10 10	0/10 0	0/10 0	7/10 70	7/10 70	10/10 100	10/10 100	4/10 40
	R	1	2	3	4	5	M	PR	T	U	N	C

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 14

Performance of release in the
Sidelying Position
Subject 3 with the Left Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	3/12 25	3/3 100	3/3 100	3/3 100	3/3 100	2/3 67	0/3 0	3/3 100	0/3 0	1/3 33	3/3 100	
BALL	5/12 42	4/5 80	4/5 80	5/5 100	5/5 100	5/5 100	0/5 0	5/5 100	0/5 0	0/5 0	2/5 40	
CUBE	9/12 75	9/9 100	9/9 100	8/9 89	9/9 100	7/9 78	0/9 0	9/9 100	0/9 0	0/9 0	8/9 89	
PELLET	9/12 75	7/9 78	7/9 89	6/9 67	1/9 11	0/9 0	0/9 0	9/9 100	1/9 11	1/9 11	9/9 100	

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

TABLE 15

Performance of Release in the
Supported Sitting Position
Subject 3 with the Left Hand

	R	1	2	3	4	5	M	PR	T	U	N	
ROD	3/12 25	3/3 100	3/3 100	3/3 100	3/3 100	3/3 100	0/3 0	3/3 100	0/3 0	1/3 33	2/3 67	
BALL	7/12 58	7/7 100	7/7 100	7/7 100	7/7 100	6/7 86	0/7 0	7/7 100	0/7 0	5/7 71	5/7 71	
CUBE	10/12 83	10/10 100	10/10 100	10/10 100	10/10 100	10/10 100	0/10 0	10/10 100	0/10 0	8/10 80	7/10 70	
PELLET	12/12 100	8/12 67	10/12 83	5/12 42	2/12 17	1/12 8	0/12 0	12/12 100	2/12 17	6/12 50	9/12 75	

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

FM(RL)41

TABLE 16

Performance of Release in the Sitting Position Subject 4 with the Left Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	3/12 25	3/3 100	3/3 100	3/3 100	3/3 100	3/3 100	0/3 0	3/3 100	0/3 0	3/3 100	3/3 100	0/3 0
BALL	7/12 58	7/7 100	7/7 100	7/7 100	7/7 100	7/7 100	0/7 0	7/7 100	0/7 0	7/7 100	2/7 29	4/7 57
CUBE	7/12 58	7/7 100	7/7 100	7/7 100	7/7 100	6/7 86	0/7 0	7/7 100	0/7 0	7/7 100	4/7 57	2/7 29
PELLET	4/12 33	3/4 75	3/4 75	1/4 25	0/4 0	0/4 0	1/4 25	3/4 75	0/4 0	4/4 100	4/4 100	2/4 50

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

FM(RL) 43

TABLE 17

Performance of release in the
Sitting Position
Subject 4 with the Right Hand

	R	1	2	3	4	5	M	PR	T	U	N	C
ROD	9/12 75	9/9 100	9/9 100	9/9 100	9/9 100	9/9 100	0/9 0	8/9 89	0/9 0	9/9 100	5/9 56	5/9 56
BALL	5/12 42	4/5 80	5/5 100	5/5 100	5/5 100	5/5 100	0/5 0	5/5 100	0/5 0	5/5 100	0/5 0	5/5 100
CUBE	5/12 42	5/5 100	5/5 100	5/5 100	5/5 100	5/5 100	1/5 20	4/5 80	0/5 0	5/5 100	4/5 80	3/5 60
PELLET	8/12 67	6/8 75	7/8 88	4/8 50	1/8 13	1/8 13	0/8 0	7/8 88	2/8 25	8/8 100	8/8 100	4/8 50

NOTE. The fraction in the upper portion of each box represents the number of times release or subsequent components of release occurred out of the number of trials possible. The ratio is expressed as percent in the lower portion of each box.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE SITTING BEHAVIOR AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results with Seven Handicapped Children[1]

by

Karin J. Barnes

and

Steven F. Warren

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[1] The procedures and data reported in this study were taken from a Master's thesis by Karin J. Barnes that was submitted to the Department of Special Education, University of Kansas, in October, 1979.

Overview of Measurement Procedures

A complete description of measurement procedures used in this study is found in pages S18 to S53 of Volume 1, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring sitting behavior were developed for the following eight positions: (1) supported sitting; (2) propped sitting; (3) come to sit from supine using truck rotation; (4) come to sit from sidelying; (5) come to sit from supine using truck flexion; (6) protective extension to the side in sitting; (7) protective extension to the back in sitting; (8) independent sitting. A brief definition of each of these positions is given below.

Supported sitting. This refers to the ability of the child to sit correctly with his/her back supported by a board placed in a position similar to a chair back. While sitting with only the board as support, the child is viewed by an observer from the side through a pice of clear plexiglass divided into three sections. Every 30 seconds during the 5-minute observation period the observer records which trisection the child's back and shoulders are in. A complete description of the procedures can be found on pages S21-25.

Propped sitting. This refers to the ability of the child to sit in propped position using one or both of his hands to maintain an upright position. Several different types of "propping" are measured including propped in one hand, two hands, one hand fixed on another body part, two hands fixed on another body part or mixed use of the hands to maintain upright sitting. Again a plexiglass device is placed parallel to the child and the position of the child's body (trunk and shoulders) in one of the three marked tri-sections is noted every 30 seconds for a 5-minute period. Complete measurement procedures can be found on pages S25-30 of Volume 1.

Come to sit from supine using trunk rotation. This refers to the ability of the child to start from a position of lying on his/her back (supine) and then to move to an upright seated position by essentially rolling over (trunk rotation) and using his/her hands to prop him/herself up, finally gaining a propped sitting position. A sequence of 10 behaviors are measured from the initial supine starting position to the final propped sitting position. The child is observed across a total of five trials. The complete measurement procedures are specified on pages S30-35 of Volume 1.

Come to sit from sidelying. This refers to the ability of the child to bring him/herself to a propped sitting position from an initial position of lying on his/her side (sidelying). A sequence of nine positions are measured from the initial sidelying position to the point where the child has attained a propped sitting position. To reach the final position the child is required to place his/her arms and hands underneath his/her body and raise up using, at different times, their hands hands, arms and elbows. The response of the the child is observed across a total of five trails. The complete measurement procedures can be found on pages S36-38 of Volume 1.

Come to sit from supine using trunk flexion. This refers to the ability of the child to raise him/herself straight up to a sitting position from an initial supine position. A sequence of nine responses is measured starting with the response of raising the head off the mat and terminating with the child sitting straight up. The child is observed moving from supine to sitting through the plexiglass trisectional device. The child is observed for a total of five trials. The complete measurement procedure can be found on pages S38-43 of Volume 1.

Protective extensive to the side in sitting. Here the ability of the child to respond when a support board he/she is leaning against is removed is measured. The child is leaned against a support board slightly, which is then suddenly removed. A large pillow is positioned to break the child's fall. Six types of responses are defined, all of which the child may display after the board is removed. A total of five trials are conducted. Complete measurement procedures can be found on pages S43-46 in Volume 1.

Protective extension to the back in sitting. This refers to the child's ability to regain or maintain a sitting position when a support board placed against his/her back is removed while he/she is seated on an incline board with his/her feet slightly higher than the rest of his/her body. Five responses are defined, any of which the child may display after the support board is removed. They range from falling backward without attempting to catch or protect him/herself, to quickly moving his/her hands to maintain position. A total of five trials are conducted. Complete measurement procedures can be found on pages S46-50 in Volume 1.

Independent sitting. The final response measured is simply the ability of the child to sit independently with no support. The child is placed in his/her optimal sitting position. The plexiglass trisectional device is placed next to the child. The observer watches the child through this device and records the child's sitting position every 30 seconds across a 5-minute period. Complete procedures can be found on pages S51-53 of Volume 1.

Subjects

Seven severely, multiply handicapped insitutionalized children served as subjects for the initial development of these measurement procedures. The subjects were chosen from three classifications of physical disability types that included "developmental delay," "spacticity," and "athetosis." The developmentally delayed subjects were those that motorically functioned lower than their chronological age but exhibited little or no abnormal physical abilities. The spastic subjects were those that exhibited hypertonic muscle tone. Athetoid subjects were those that exhibited abnormal and uncontrolled movements of body parts. In order to be included in the study, it was required that each subject be able to maintain head erect position in sitting for 5 seconds.

Subject 1. SB was a 10-year-old female with hypotonic quadraplegia. Her functional motor development level was 5½ months. She was able to raise and maintain her head in an erect position for several minutes and rotate her trunk while in supine position. SB was not able to sit independently.

Subject 2. JD was a 7-year-old female with a slight muscle weakness on the left side of her body. Her motor development level was 1½ years. She was able to stand, walk and sit independently.

Subject 3. RM was a 6-year-old female with mild hypertonic quadraplegia. Her motor developmental level was 9 months. She sat with support and stood with physical assistance.

Subject 4. TF was a 12-year-old female. Her motor development level was 4 years. She could sit and walk independently, but with poor balance.

Subject 5. BS was a 14-year-old male with athetoid quadraplegia. His motor development level was 1½ years. He had independent head control, could roll over from supine and prone, and sit with support.

Subject 6. RJ was a 12-year-old male with hypertonic quadraplegia. His motor development level was three months. He was able to hold his head erect in sitting up to three minutes. He was able to voluntarily extend his trunk but could not sit independently. He did not functionally use his arms and hands.

Subject 7. DI was a 9-year-old male with a developmental delay and mild spasticity in the lower extremities. His motor development level was 9 months. He was able to hold his head erect and reach and grasp objects with both arms.

Procedures for Obtaining Measures of Reliability

Integral to the process of developing these measurement procedures was the assessment of reliability between independent observers across the eight defined sitting positions. Interobserver reliabilities were taken, using observers with varying degrees of expertise in motor training and data collection procedures. Reliabilities were recorded by having two observers simultaneously record the subjects' responses. Each measurement procedure for each critical skill had interobserver reliabilities taken for at least five sessions. Frequency scores were compared for reliability by using the following formula:

$$R \text{ (reliability)} = \frac{\text{Total No. Trials Agreed}}{\text{Total No. Possible Trails}} \times 100$$

The duration scores had reliabilities calculated in the following manner:

$$R = \frac{\text{Smallest Duration}}{\text{Largest Duration}} \times 100.$$

The interval scores had reliabilities calculated by comparing the two observers' scores interval-by-interval in order to determine the percentage of intervals in which the two observers agreed that the behavior did or did not occur. The following formula was used: $R = \frac{O_{1\&2} + N_{1\&2}}{T} \times 100$

in which: $O_{1\&2}$ = The number of intervals that both observers recorded the behaivor as occurring;

$N_{1\&2}$ = The number of intervals that both observers recorded the behavior was not occuring; and

T = The total number of intervals from which the two observers' records were compared.

Results

A total of 19 observers, with varying degrees of expertise in training severely, multiply handicapped individuals, took reliability during the initial development of the assessment procedures. The reliability scores they obtained for each sitting position are presented in Tables 1-8. These results are summarized below.

Supported sitting. A total of 22 reliability observatons across four subjects were taken involving 11 different observers. Reliability scores on duration of sitting ranged from 92% to 100% with an overall mean of 99%. Time sample reliability never fell below 100% (see Table 2).

Propped Sitting. Twenty-two reliability observations were taken across four subjects and 11 observers. No reliability score on either duration or time sample ever fell below 100% (see Table 2).

Come to sit from supine using trunk rotation. A total of 30 reliability observations across five subjects and 11 observers were taken. Reliability scores on the frequency of the various responses defined by this position ranged from 90-100% and overall mean reliability on frequency of occurence was 97% (see Table 3).

Come to sit from sidelying. A total of 22 reliability observations across four subjects and 12 observers were taken. Reliability scores on

Table 1

Reliability Scores for Supported Sitting

Subject	Reliability Session Number	Observers		Reliability Scores Per Session		Mean Reliability Scores	
				Duration	Time Sample	Duration	Time Sample
1	1	KB	DS	96	100	98	100
	2	KB	ML	98	100		
	3	KB	DS	100	100		
	4	KB	BP	98	100		
	5	KB	MC	100	100		
	6	KB	MC	100	100		
	7	KB	NB	100	100		
5	1	KB	MT	100	100	100	100
	2	KB	SZ	100	100		
	3	KB	RB	100	100		
	4	KB	BP	100	100		
	5	KB	CA	100	100		
6	1	KB	MC	94	100	97	100
	2	KB	BP	92	100		
	3	KB	SZ	100	100		
	4	KB	BP	100	100		
	5	KB	RB	100	100		
7	1	KB	PD	100	100	100	100
	2	KB	BP	100	100		
	3	KB	CA	100	100		
	4	KB	SZ	100	100		
	5	KB	CA	100	100		

Table 2

Reliability Scores for Propped Sitting

Subject	Reliability Session Number	Observers		Reliability Scores Per Session		Mean Reliability Scores	
				Duration	Time Sample	Duration	Time Sample
1	1	KB	DS	100	100	100	100
	2	KB	DS	100	100		
	3	KB	SZ	100	100		
	4	KB	MC	100	100		
	5	KB	MC	100	100		
	6	KB	CA	100	100		
	7	KB	CJ	100	100		
5	1	KB	SZ	100	100	100	100
	2	KB	RB	100	100		
	3	KB	RB	100	100		
	4	KB	BP	100	100		
	5	KB	CA	100	100		
6	1	KB	SZ	100	100	100	100
	2	KB	SZ	100	100		
	3	KB	SZ	100	100		
	4	KB	SZ	100	100		
	5	KB	RB	100	100		
7	1	KB	BP	100	100	100	100
	2	KB	BP	100	100		
	3	KB	CA	100	100		
	4	KB	SZ	100	100		
	5	KB	CA	100	100		

Table 3

Reliability Scores for Come to Sit from Supine using Trunk Rotation

Subject	Reliability Session Number	Observers		Reliability Scores of Frequency Per Session	Mean Reliability Score
2	1	KB	DS	100	99
	2	KB	ML	100	
	3	KB	DS	100	
	4	KB	DS	100	
	5	KB	ML	100	
	6	KB	ML	100	
	7	KB	ML	100	
	8	KB	NC	100	
	9	KB	RB	100	
	10	KB	CA	100	
	11	KB	CA	100	
	12	KB	BP	96	
3	1	NC	NM	100	100
5	1	KB	ML	98	95
	2	KB	BP	98	
	3	KB	NC	94	
	4	KB	MC	90	
	5	KB	BP	90	
	6	KB	CA	100	
	7	KB	CJ	98	
6	1	KB	BP	96	98
	2	KB	KD	96	
	3	KB	KD	100	
	4	KB	BP	100	
	5	KB	RB	100	
7	1	KB	BP	94	94
	2	KB	BP	90	
	3	KB	BP	100	
	4	KB	BP	100	
	5	KB	RB	90	

Table 4

Reliability Scores for Come to Sit from Sidelying

Subject	Reliability Session Number	Observers		Reliability Scores of Frequency Per Session	Mean Reliability Score
2	1	KB	CA	100	98
	2	KB	NC	97	
	3	KB	FB	97	
	4	KB	RB	100	
	5	KB	SZ	97	
5	1	KB	BA	100	94
	2	KB	NC	97	
	3	KB	NC	73	
	4	KB	CA	88	
	5	KB	RB	100	
	6	KB	MT	100	
	7	KB	BP	100	
6	1	KB	NM	100	98
	2	KB	MC	97	
	3	KB	BP	95	
	4	KB	KD	100	
	5	KB	BP	100	
7	1	KB	BP	100	98
	2	KB	BP	100	
	3	KB	MT	100	
	4	KB	SZ	100	
	5	KB	RB	90	

Reliability Scores for Come to Sit from Supine using Trunk Flexion

Subject	Reliability Session Number	Observers		Reliability Scores of Frequency Per Session	Mean Reliability Score
4	1	KB	CA	100	99
	2	KB	SZ	100	
	3	KB	BP	100	
	4	KB	BP	97	
	5	KB	CA	100	
5	1	KB	CA	96	97
	2	KB	MT	90	
	3	KB	CA	100	
	4	KB	CA	100	
	5	KB	CA	100	
6	1	KB	MC	100	100
	2	KB	FB	100	
	3	KB	BP	100	
	4	KB	CJ	100	
	5	KB	RB	100	
7	1	KB	CA	100	100
	2	KB	BP	100	
	3	KB	BP	100	
	4	KB	CA	100	
	5	KB	SZ	100	

Table 6

Reliability Scores for Protective Extension to Sides

Subject	Reliability Session Number	Observers		Reliability Scores of Frequency Per Session	Mean Reliability Score
4	1	KB	CJ	100	96
	2	KB	CJ	90	
	3	KB	RB	100	
	4	KB	RB	100	
	5	KB	MS	90	
5	1	KB	CJ	90	96
	2	KB	MT	90	
	3	KB	MT	100	
	4	KB	BP	100	
	5	KB	RB	100	
6	1	KB	RB	100	100
	2	KB	BP	100	
	3	KB	NM	100	
	4	KB	BP	100	
	5	KB	FB	100	
7	1	KB	MT	70	92
	2	KB	BP	90	
	3	KB	CA	100	
	4	KB	CA	100	
	5	KB	SZ	100	

Reliability Scores for Protective Extension to Back

Subject	Reliability Session Number	Observers		Reliability Scores of Frequency Per Session	Mean Reliability Score
4	1	KB	CJ	90	98
	2	KB	RB	100	
	3	KB	CJ	100	
	4	KB	CA	100	
	5	KB	CA	100	
5	1	KB	CJ	100	98
	2	KB	KB	90	
	3	KB	RB	100	
	4	KB	MT	100	
	5	KB	CA	100	
6	1	KB	RB	100	98
	2	KB	CA	100	
	3	KB	BP	100	
	4	KB	BP	100	
	5	KB	RB	90	
7	1	KB	MT	90	96
	2	KB	BP	100	
	3	KB	BP	100	
	4	KB	MT	100	
	5	KB	CA	90	

Table 8

Reliable Scores for Independent Sitting

Subject	Reliability Session Number	Observers		Reliability Scores Per Session		Mean Reliability Scores	
				Duration	Time Sample	Duration	Time Sample
2	1	KB	BP	99	100	97	100
	2	KB	CA	97	100		
	3	KB	FB	97	100		
	4	KB	CJ	94	100		
	5	KB	CJ	97	100		
5	1	KB	DS	100	100	100	100
	2	KB	NM	100	100		
	3	KB	SZ	100	100		
	4	KB	CA	100	100		
	5	KB	MT	100	100		
6	1	KB	BP	100	100	100	100
	2	KB	FB	100	100		
	3	KB	NM	100	100		
	4	KB	BP	100	100		
	5	KB	SZ	100	100		
	6	KB	CJ	100	100		
	7	KB	BP	100	100		
7	1	KB	AN	99	100	97	100
	2	KB	DS	83	100		
	3	KB	DS	100	100		
	4	KB	PD	100	100		
	5	KB	BP	100	100		

frequency ranged from 73-100% with an overall mean of 97% (see Table 4).

Come to sit from supine using trunk flexion. For this measurement position a total of 20 observations across four subjects and nine observers were taken. Reliability scores on frequency ranged from 90-100% with an overall mean of 99% (see Table 5).

Protective extension to sides. For this position a total of 20 observation were taken across four subjects and 10 observers. Reliability on frequency ranged from 70-100% with an overall mean of 96% (see Table 6).

Protective extension to back. For this position a total of 20 reliability observations were taken across four subjects and seven observers. Reliability on frequency of response ranged from 90-100% with an overall mean of 98% (see Table 7).

Independent sitting. A total of 22 reliability observations were taken for independent sitting across four subjects and 11 observers. Reliability never fell below 100% (see Table 8.)

Discussion

A number of features were inherent in the initial development of measurement procedures. All eight positions selected for measurement were done so because of widespread agreement among researchers and clinicians from varied backgrounds as to their importance to development and proper motoric functioning. The measures developed to index these skills are, compared to more traditional assessments, ususally sensitive to small behavior changes and increments. The use of duration and frequency measures to index the functionality of each response measured provides a much more detailed picture of the child's functioning level within each skill than simple and traditional measures that only specify whether or not the child has the response in his/her repertoire. Yet despite the relative sophistication of these measures they are generally simple and easy to use, require relatively inexpensive and simple measurement apparatus, and to the extent they have been tested, have proven highly reliable.

Despite the inherent strengths of the initial analyses, much remains to be done. The procedures require further fine-tuning and modification. Some are still lengthy and relatively detailed, perhaps more so than necessary. The reliability over time and with different populations, such as normal infants and other types of handicapped children, must be established first and foremost.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE HEAD ERECT BEHAVIOR AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with Two Nonhandicapped Infants and Three Handicapped Children[1]

by

Kathleeen J. Foshage

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[1] The procedures and data reported in this study were taken from a Master's thesis by Kathleen J. Foshage that was submitted to the Department of Special Education, University of Kansas, in October, 1978.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages HE1 to HE41 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring head erect behavior were developed for the following three positions: prone, supported sitting, and pull to sit and recline.

Prone Position. Two observation schedules were used for measuring head erect in the prone position. Schedule A was used for children who were initially measured to hold up their heads for less than 60 seconds during a three minute observation period. In using Schedule A, the child was observed continuously for a three minute period. Head bobs were recorded when the child raised the head for less than five seconds. Duration of time was recorded for all responses in which the head was held erect for greater than five seconds. Additionally, the position of the child's arms was recorded for each occurrence in which the head was held erect for greater than five seconds.

Observation Schedule B was used for children who initially were observed to hold their heads erect for 60 or more cumulative seconds during a three minute period. In using this schedule, duration of head erect behavior, up to three minutes each, was observed across five to 10 trials in a session. Arm positions were also recorded during each trial.

Supported Sitting Positions. In this procedure the child was placed sitting on an adult's lap. A piece of plexiglass divided by masking tape into 30°, 60°, and 90° angles was placed on a table at parallel to the child's trunk and head. Head erect was scored if the child maintained the head position between the 60° and 90° angle on the trisection device. Initial observations determined if the child could maintain head erect behavior for greater than 25 seconds during a three minute period. If not, a frequency count was used in which the number of responses were recorded during a three minute period in which the head was raised above the 60° angle on the trisection device.

A duration measure was used for children who were initially measured to hold their heads erect for greater than 25 seconds in a three minute period. In this procedure, total duration of head erect behavior was recorded in the three minute observation period.

Pull to Sit and Recline Positions. In this procedure the child was placed in the supine position on the floor. The trisection device was placed parallel to the child's trunk and head. A velcro band was placed around the child's chest. This was used to attach a tape from the chest to the child's chin. The child was slowly pulled from the supine to the sitting position, and then lowered back again to the supine (recline) position. Recordings were made to each of the three trisection areas (0°-30°, 30°-60°, 60°-90°) in which the head remained in alignment with the trunk. These records were made as the child was pulled to the sitting position and as the child was lowered back to the recline position. Detachment of the tape was used to assist in determining when head control was lost. Five trials each of pull to sit and recline to supine were performed in each session.

Subjects

This study included both preschool multiply handicapped children and nonhandicapped infants. The three multiply handicapped subjects were selected from the Preschool for the Severely Multiply Handicapped at

Kansas University Medical Center. Selection criteria included: (a) deficiency in head control, and (b) absence of obligatory tonic labyrinthine reflex.

Subject 1. Sam was a three year old male with spastic quadriparesis, seizure disorder, and severe developmental delay. According to the motor development section of the Callier-Azusa Scale (1977), Same was functioning below the six month level. He had a voluntary reach and grasp, but was unable to roll or sit independently. Sam could move his head laterally, but he had little head erect behavior.

Subject 2. Mike was a three year old make with spastic quadriparesis, seizure disorder, and severe development delay. According to the motor development section of the Callier-Azusa Scale (1977), Mike was also functioning below the six month level. He was unable to roll or sit independently and did not have a voluntary grasp. Mike could lift his head in the prone and supported sitting positions.

Subject 3. Julie was a 3 year 8 months old female with spastic quadriparesis and a severe/profound hearing loss. According to the motor section of the Callier-Azusa Scale (1977), Julie was functioning at approximately the six month level. She could both roll and sit independently when positioned. She had a voluntary reach, grasp, and release with her right hand. Julie demonstrated good head control in the pull to sit and supported sitting positions.

The two nonhandicapped subjects were measured for head erect behavior only in the prone position.

Subject 4. Abe was a normally developing male who was observed from four to 17 weeks of age.

Subject 5. Rory was a normally developing male who was observed from three to 16 weeks of age.

Procedures for Obtaining Measures of Reliability

The following procedures were used for taking and calculating interobserver agreements for measuring head erect behavior in each of the three positions.

Prone Position

Reliability measures on the multiply handicapped subjects were taken from direct observation in the classroom and from videotapes made in the classroom.

Observers participating in reliability measurements on the multiply handicapped subjects include the investigator, two occupational therapists, and a special education teacher. Persons participating in the reliability measures for the two nonhandicapped infants included the investigator, an occupational therapist and a physical therapist.

Reliability measure were computed by one of two methods, depending on whether or not the child was observed for Schedule A (the 3 minute session) or for Schedule B (five to 10 trials).

Schedule A (Three-minute Sessions). Arm positon was not recorded for bobs when a 3-minute session was used. Duration and arm position were recorded when the head was erect greater than or equal to 60 seconds. Arm position was scored as no support, forearm support, or one forearm support and one extended arm support.

Reliability data were obtained across three observers on one handicapped child, Sam, and both of the nonhandicapped infants, Abe and Rory. Sam never maintained head erect longer than 5 seconds, so reliability was computed on the number of bobs he made during the 3 minute sessions using the following formula:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \times 100$$

The reliability figures from each session were added together and divided by the number of sessions to obtain the average reliability figure for this position.

Percent of agreement for the 3 minute session were computed separately for the two honhandicapped infants when head raises were longer than 5 seconds. This was done by using the following two formulas for head erect duration and arm position.

$$1.\ \text{Percent reliability for duration} = \frac{\text{smaller duration}}{\text{larger duration}} \times 100$$

Bobs were counted in this duration figure as 100% agreement if each examine scored a bob, or as 0% agreement if one examiner scored a bob and one examiner did not. Percentages from all the trials were added together and divided by the number of head raises greater than 5 seconds to obtain a reliability percent per session. The reliability scores from each session were added together and divided by the total number of sessions to obtain the average reliability figure for duration.

$$2.\ \text{Percent reliability on arm position} = \frac{\text{\#of agreements}}{\text{\# of disagreements + agreements}} \times 100$$

This percent for arm position was computed only on head raises longer than 5 seconds. Each observer rocorded arm positon for each occasion in which the head was held erect for greater than 5 seconds. The reliability scores from each session were added together and divided by the number of sessions to obtain the average reliability figure for arm positon.

Schedule B (Five to 10 trial method). Reliabiltiy data were obtained on two multiply handicapped children, Mike (Subject 2) and Julie (Subject 3). Percent of agreement on duration was computed as follows: The smaller duration nujmber was divided by the larger duration number and multiplied by 100 to obtain a percentage for each trial. This provided one percentage number per trial. These percentage numbers (one per trial) were added together and divided by the number of sessions to obtain the average reliability score.

Supported Sitting Position

The reliability measures were performed separately for frequency and duration recordings.

Frequency recordings. The 3-minute observation period was divided into 20, 10-second intervals for taking measures of reliability to ensure that the observers were scoring the same behavior. The number of head movements above 60° when the neck was not hyperextended and the head was not completely beyond the vertical edge of the trisection device were recorded for each of the 20, 10-second intervals.

The number of agreements and number of disagreements between observers was recorded for each interval. The total number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to obtain the reliability score for each session. Percentage scores from each session were added together and divided by the total number of sessions to obtain the average reliability percentage.

Reliability measures were obtained from videotapes filmed in the classroom on Subject 1, Sam. Observations were performed by the investigator and one occuaptional therapist.

Duration recordings. Each observer's duration recordings for head erect were compared. The smaller duration number was divided by the larger duration number and multiplied by 100 to obtain a reliability percentage for each head erect movement. These percentages were added together and divided by the total number of head erect movements to obtain the overall reliability percentage for each session. The scores for each session were added together and divided by the total number of sessions to obtain the average reliability score.

Pull to Sit and Recline Positions

Reliability measures were taken from direct observation and from video tapes made in the classroom. Agreement/nonagreement data were obtained for each trisection on each pull to sit and each recline trial. The total number of agreements for each session was divided by the total number of agreements plus disagreements and multiplied by 100 to obtain a percent reliability.

Reliability data were obtained across four observers on the three handicapped children (Sam, Mike, and Julie). The four observers included the investigator, one occupational therapist, one physical therapist, and a nurse.

Percentage scores from each session were added together, then divided by the total number of sessions to obtain the average reliability percentage for the pull to sit and recline positions.

Results

Reliability scores representing percent agreements between observers for each of the positions are presented. The percents for head erect behavior (and arm position) are shown for each subject that was involved in the procedures.

Prone Position

Table 1 shows reliabilty scores from the three handicapped children (Subject 1: Sam; Subject 2: Mike; and Subject 3: Julie) and the two nonhandicapped infants (Subject 4: Abe; and Subject 5: Rory). The reliability percents reflect both the 3 minute (Schedule A) and the 10-trial (Schedule B) measurement procedures. These percents show good agreement for both head erect behavior and arm position.

Table 1

Reliability Scores for the Prone Position

		Reliability Scores per Session		Mean Reliability Score	
Subject	Method	Duration	Arm Position	Duration	Arm Position
1	3 min.	88		93	
		91			
		100			
2	10 trial	97	81	98	91
		98	91		
		98	100		
3	10 trial	93	92	96	92
		96	86		
		100	97		
4	3 min.	95	100	94	96
		95	95		
		94	92		
		93			
		93			
		94			
5	3 min.	88	100	93	98
		92	100		
		94	93		
		86			
		100			
		100			

Supported Sitting Position

Reliability scores between observers for the supported sitting position are presented in Table 2 for each of the three handicapped children. These scores reflect percent agreements for both the frequency and duration measurement procedures. Again, mean reliability scores remain quite good, ranging from a mean reliability of 88% agreement for the frequency measurement procedure (Subject 1) to 95% mean agreement for the duration measurement procedure used with Subject 3.

Pull to Sit and Recline Positions

Table 3 presents reliabilty scores for the pull to sit and recline positions from the three handicapped children (Subjects 1, 2, and 3). Mean reliabilities all remain above 90% for each of the three children. Individual reliability scores for individual sessions range from 87% to 100%.

Pilot Data with Two Nonhandicapped Infants

During the process of developing the procedures for measuring head erect behavior, it was possible to collect limited longitudinal data on two nonhandicapped infants; Abe (Subject 3) and Rory (Subject 5). These data were taken, primairly, by each child's mother who was provided training in using the measurement procedures. Subject 4 was observed for head erect behavior in the prone position from 29 to 116 days of age. Subject 5 was observed in the prone position from 23 to 110 days of age. These data, presented in Figures 1 and 2 show head bobs per minute during a three minute observation period, the longest duration of head erect recorded during a three minute period, and position of the arms recorded for those durations of 5 seconds or longer.

Subject 4. Three distinct phases of head erect development are illustrated in Figure 1. In the first phase (29 to 52 days of age), bobs per minute gradually increase from three to 11 bobs per minute.

Table 2

Reliability Scores for the Supported Sitting Position

Subject	Method	Reliability Scores per Session	Mean Reliability Score
1	Frequency	81	88
		87	
		95	
2	Duration	88	93
		93	
		99	
3	Duration	92	95
		96	
		99	
		93	

Table 3

Reliability Scores for the Pull to Sit and Recline Positions

Subject	Method	Reliability Scores per Session	Mean Reliability Score
1	5 trial	87	90
		90	
		93	
2	5 trial	100	100
		100	
		100	
3	5 trial	90	97
		93	
		93	
		97	
		100	
		100	
		100	
		100	

HE13

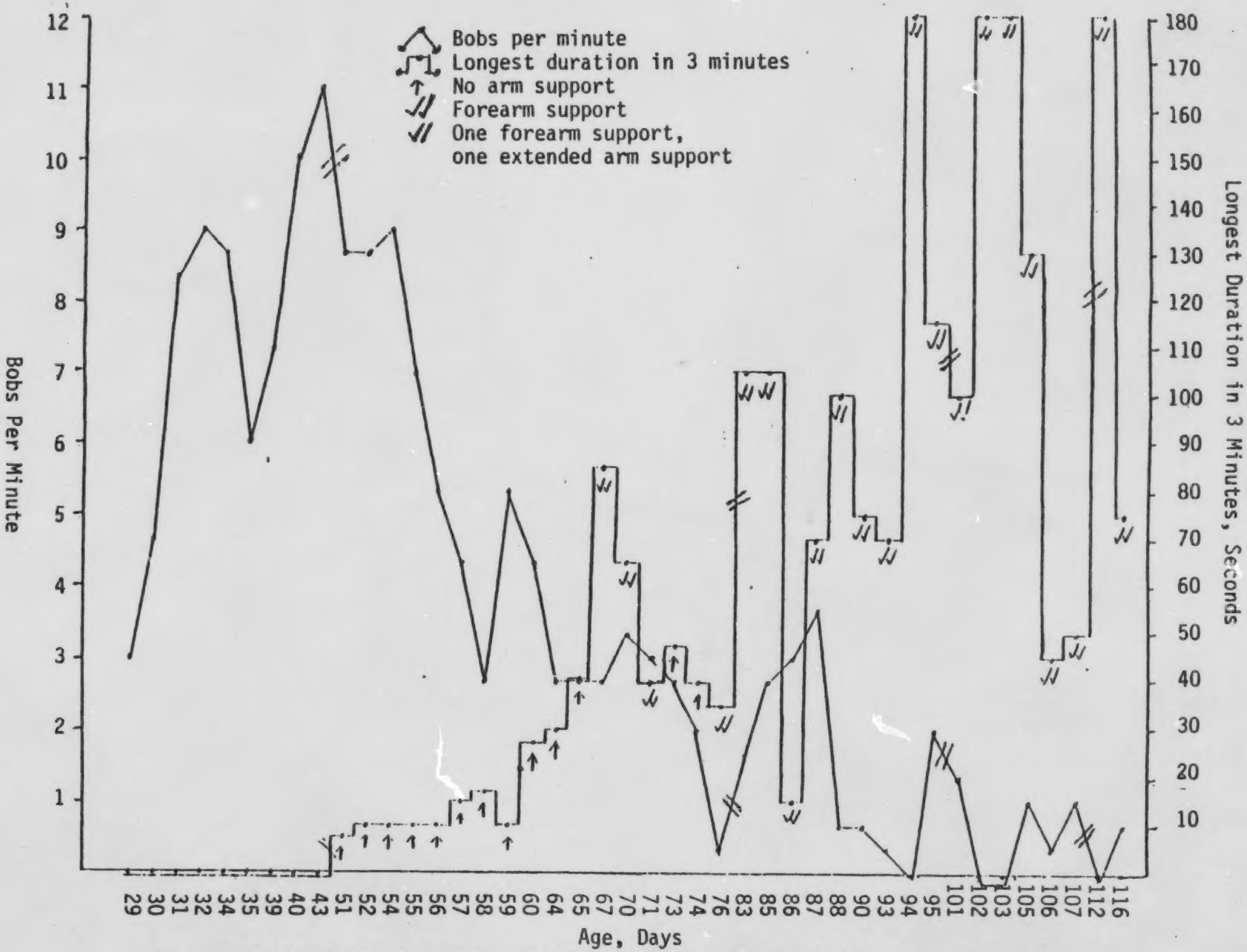

Figure 1: Head Erect Behavior in Prone Position by Nonhandicapped Subject 4

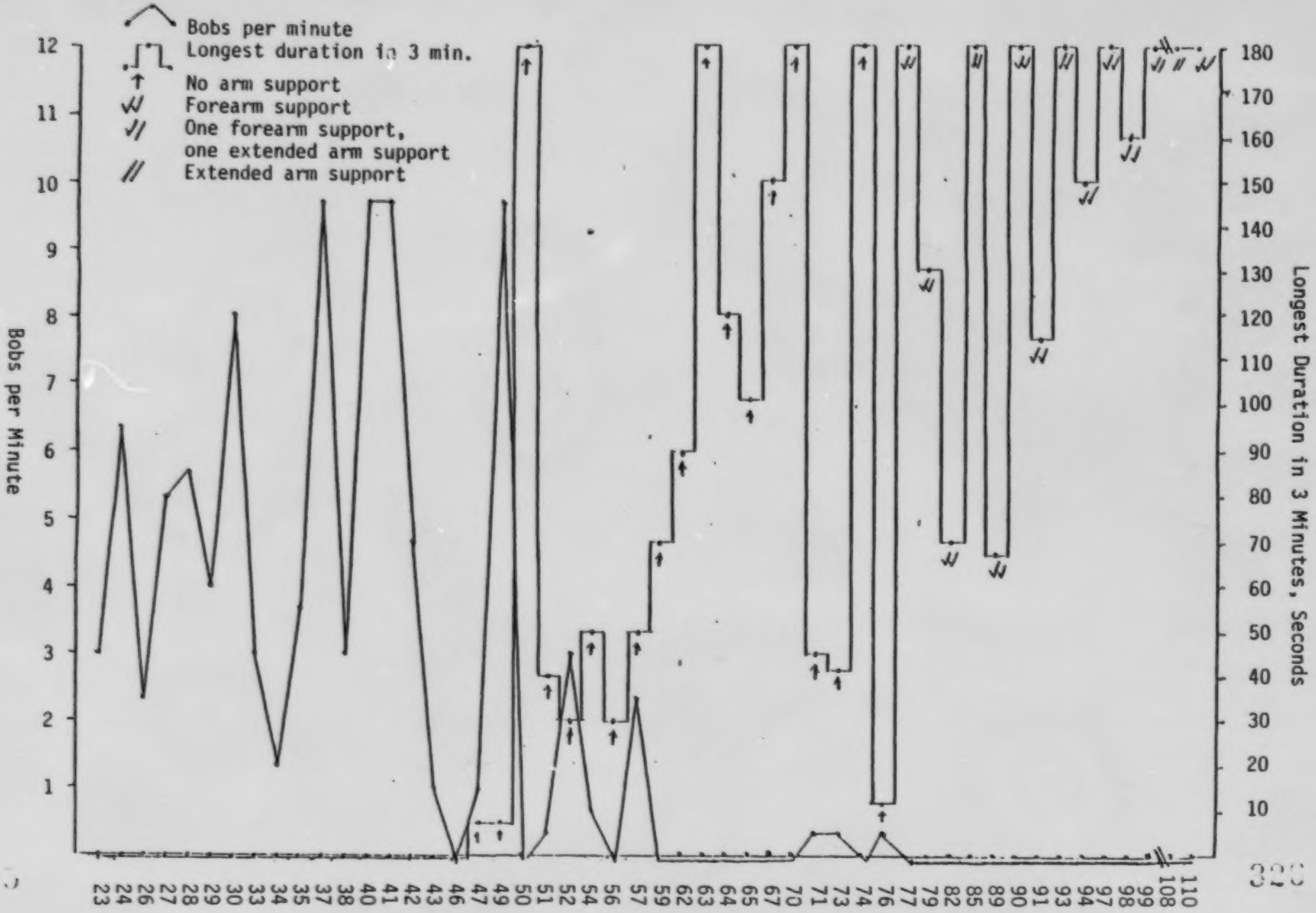

Figure 2: Head Erect Behavior in Prone Position by Nonhandicapped Subject 5

The second phase is one of transition between decreasing bobs per minute and increasing duration. This phase occurs from 52 days to 95 days of age. From days 52 to 58 there is a gradual and consistent decline in bobs per minute from nine to less than three. At this same time, duration of head erect behavior is gradually increasing to almost 20 seconds. Following this stage is a period of fluctuation in which bobs per minute and longest duration scores vary widely. This phase also presents variability in arm position. Only one position, no arm support, was demonstrated in phase one. In phase two, there is some fluctuation between no arm support and forearm support. No arm support is most frequently observed at the beginning of this phase with forearm support most frequently observed at the end of this phase.

The third phase is from 95 days to 116 days of age. Here, the number of bobs decreases and remains low while duration scores are consistently high. During this period, forearm support is consistently demonstrated with two occasions of support on one extended arm and one forearem.

Subject 5. These same general trends are observed in Subject 5 (Figure 2). Phase one occurs from 23 days to 42 days of age. During this time bobs per minute are generally increasing.

A transition period (phase two) is observed from 42 days to 57 days of age. Both measures vacillate between their highest and lowest points. Arm position is consistent during this period (i.e., no arm support). Phase three occurs from 57 days to 110 days of age. During this time, bobs per minute decrease and remain low while the longest duration increases and remains consistently high with few exceptions.

Arm position is clearly divided between no arm support in phase one and phase two and forearm support in phase three. The first 12 data points in phase three occur with no arm support. The last 14 points occur with forearm support with one instance of support on one forearm and one extended arm and one instance of support on extended arms, both near the end of the phase.

The complete data recorded, by days, for Subject 4 and Subject 5 are presented in Table 4.

Discussion

The data collected on the two nonhandicapped infants in the prone position indicate that this measurement procedure provides a tool that is sensitive to subtle changes in performance, provides operationally defined behaviors, and provides a system for quantifying the behavior.

The data seem to indicate that head bobs/minute continue to increase until the head erect position lasts longer than 5 seconds. At this time, it appears the bobs/minute begin to decrease and continue to decrease as duration of head erect increases. In addition, changes in arm position i.e., from no arm support to propping on forearms, appears to be positively correlated with an increase in duration of head erect behavior.

Some limitations of this procedure are: (a) the observation period is too short to accommodate continued development of head erect behavior because after the child consistently raises the head for 3 minutes the system fails to show further development other than arm position, (b) no measure is provided for height of head raise. Further research is indicated to determine if inclusion of height of head raise provides a more sensitive measurement of head erect ability in the prone position or if this information positively correlates with arm position, and (c) measurements in this position with nonhandicapped children should be performed in the same way as the handicapped children to make comparison of development more meaningful.

Table 4

Head Erect Behavior in the Prone Position
Non-Handicapped Subjects

	Subject 4		Subject 5			Subject 4		Subject 5	
Age (days)	Bobs/ Min.	Longest Duration (seconds) with Arm Position	Bobs/ Min.	Longest Duration (seconds) with Arm Position	Age (days)	Bobs/ Min.	Longest Duration (seconds) with Arm Position	Bobs/ Min.	Longest Duration (seconds) with Arm Position
23	-	-	3	0	48	-	-	-	-
24	-	-	6.3	0	49	-	-	9.7	8 ↑
25	-	-	-	-	50	-	-	0	180 ↑
26	-	-	2.3	0	51	8.7	7 ↑	.3	40 ↑
27	-	-	5.3	0	52	8.7	10 ↑	3	30 ↑
28	-	-	5.7	0	53	-	-	-	-
29	3	0	4	0	54	9	10 ↑	.7	50 ↑
30	4.7	0	8	0	55	7	10 ↑	-	-
31	8.3	0	-	-	56	5.3	10 ↑	0	30 ↑
32	9	0	-	-	57	4.3	15 ↑	2.3	50 ↑
33	-	-	3	0	58	2.7	17 ↑	-	-
34	8.7	0	1.3	0	59	5.3	10 ↑	0	70 ↑
35	6	0	3.7	0	60	4.3	27 ↑	-	-
36	-	-	-	-	61	-	-	-	-
37	-	-	9.7	0	62	-	-	0	90 ↑
38	-	-	3	0	63	-	-	0	180 ↑
39	7.3	0	-	-	64	2.7	30 ↑	0	120 ↑
40	10	0	9.7	0	65	2.7	40 ↑	0	102 ↑
41	-	-	9.7	0	66	-	-	-	-
42	-	-	4.7	0	67	2.7	85 ✓✓	0	150 ↑
43	11	0	1	0	68	-	-	-	-
44	-	-	-	-	69	-	-	-	-
45	-	-	-	-	70	3.3	65 ✓✓	0	180 ↑
46	-	-	0	0	71	3	40 ✓✓	.3	45 ↑
47	-	-	1	8 ↑	72	-	-	-	-

Table 4 (cont.)

73	2.7	47 ↑	.3	42 ↑
74	2	40 ↑	0	180 ↑
75	-	-	-	-
76	.3	35 ✓✓	.3	13 ↑
77	-	-	0	180 ✓✓
78	-	-	-	-
79	-	-	0	130 ✓✓
80	-	-	-	-
81	-	-	-	-
82	-	-	0	70 ✓✓
83	1.7	105 ✓✓	-	-
84	-	-	-	-
85	2.7	105 ✓✓	0	180 ✓✓
86	3	15 ✓✓	-	-
87	3.7	70 ✓✓	-	-
88	.7	100 ✓✓	-	-
89	-	-	0	67 ✓✓
90	.7	75 ✓✓	0	180 ✓✓
91	-	-	0	115 ✓✓
92	-	-	-	-
93	.3	70 ✓✓	0	180 ✓✓
94	0	180 ✓✓	0	150 ✓✓
95	2	115 ✓✓	-	-
96	-	-	-	-
97	-	-	0	180 ✓✓
98	-	-	0	160 ✓✓
99	-	-	0	180 ✓//
100	-	-	-	-
101	1.3	100 ✓✓	-	-
102	0	180 ✓✓	-	-
103	0	180 ✓//	-	-
104	-	-	-	-
105	1	130 ✓✓	-	-
106	.3	45 ✓✓	-	-
107	1	50 ✓✓	-	-
108	-	-	0	180 ✓//
109	-	-	-	-
110	-	-	0	180 ✓✓
111	-	-		
112	0	180 ✓//		
113	-	-		
114	-	-		
115	-	-		
116	.7	75 ✓✓		

↑ - no arm support

✓✓ - forearm support

✓// - one forearm support, one
extended arm support

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE ROLLING BEHAVIOR AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with Two Nonhandicapped and Two Handicapped Children[1]

by

Paula Day, Jane Rues

and Donna Lehr

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[1] The procedures and data reported in this study were taken from a Master's thesis by Paula Day that was submitted to the Department of Special Education, University of Kansas, in July 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages M(R) 1 through M(R) 25 Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring segmental and mobility rolling were developed.

Segmental Rolling

Measures of the behaviors involved in the performance of segmental rolling were taken after the initial positioning of the child in prone, supine and sidelying. Observations were recorded for (1) the amount rolled by the child express as degrees, (2) the amount of trunk rotation, and (3) the amount of time taken by the child to roll.

To obtain measures of the degrees rolled and degrees of trunk rotation, coded elastic bands were used. Two bands placed around the child's hip and chest were color and line coded to indicate 16 equal parts of a circle (22.5° each). To measure the degrees rolled, the band on the child's hips was observed using this child's side as an initial reference point. Each successive part viewed as the child rolls represented an additional 22.5 degrees of rolling. Measurements of trunk rotation were observed by viewing the relationship of the hip and chest band to each other. Using the side as an initial reference point differences in the alignment of the two bands were noted, indicating the amount of trunk rotation.

The duration measures were taken by recording the amount of time the child took to roll from either prone to supine, supine to prone, sidelying to prone or supine, if the time was less than the total predetermined length of the trial.

Mobility Rolling

Measurement of rolling mobility, which is rolling prone to supine and supine to prone as a means of locomotion, consisted of recording (1) the number of complete rolls; (2) maximum degrees of body rotation observed; (3) the distance the child traveled; and (4) the time required to move the distance. After the child was positioned in either prone or supine positions the child was encouraged to roll either to the right or left.

The number of rolls was observed by simply counting the number of 360° rolls (prone to prone or supine to supine) demonstrated. Partial credit was given for at least 180° rolls (prone to prone or supine to prone).

Degrees of body rotation was measured by observing the difference in alignment between the hip and chest bands. The largest amount of difference observed with the trial was noted.

The distance traveled was recorded by measuring the distance between the starting and stopping points. If the time the child travels a distance of six feet is less than the two minutes trial time, the time taken is also recorded.

Subjects

This study included both pre-school multiply handicapped children and non-handicapped infants. The two handicapped subjects were from the Infant Development Center in Shawnee Mission, Kansas. Selection criteria for subjects included: a) adequate head control to support self on forearms and raise head to 45°; and b) the absence of obligatory asymetrical tonic neck reflex and tonic labyrinthine reflex.

Subject 1. Brian was a seven month old male with Downs Syndrome. According to the Gesell and Michigan Developmental Schedules he was functioning at the four month level in gross motor development and six month level in fine motor development. Brian demonstrated good head control in the prone and supported sitting positions. He had voluntary reach and grasp and visually pursued lost objects. Brian was unable to roll or sit independently.

Subject 2. Diane was a normally developing female twin who was observed from five to seven months of age. She displayed good head control in both prone and sitting positions. She was able to maintain a sitting position but unable to assume the position independently. Initially, Diane was not rolling as a means of mobility but she quickly acquired the skill and was also assuming a hands and knees position.

Subject 3. Rita was a normally developing female twin who was observed from five to seven months of age. She displayed good head control in both prone and sitting positions. She was able to maintain a sitting position but unable to assume the position independently. Initially, Rita was not rolling as a means of mobility but she quickly acquired the skill and was also assuming a hands and knees position.

Subject 4. Julie was a three year old female with spastic quadraparesis. According to the Gesell and Michigan Developmental Schedules she was functioning at the thirty-six month level in fine motor development and at the thirteen and one half month level in gross motor development. Julie was able to cruise, walk with hands held, push a weighted wagon and seat self in a samll chair. Hypertonicity was noted in all extremities and trunk with extensor to one predominating in lower extremities while flexor tone was observed more in the upper extremities. Fine motor activities were within normal limits.

Procedures for Obtaining Measures of Relibility

Observers participating in reliability measures on the multiply handicapped subjects included the investigator, a physical therapist and a special education teacher. Persons participating in reliability measures for the two non-handicapped infants included the investigator, an occupational therapist and a psychology major.

Reliability data was obtained across three observers on all subjects. Scores were considered reliable at a level of 80% with two observers on two consecutive sessions.

Segmental Rolling

Reliability percentages for the degrees of body rotation, degrees independently rolled and time elasped from the start to the end of each trial were recorded separately. Measures of duration were considered in agreement if scores were within five seconds of each other. For each session across all trials, the number of agreements and the number of disagreements for the three categories were tallied, using the following formula to determine reliability scores:

$$\frac{\text{\# of agreements}}{\text{\# of agreements and disagreements}} \quad \text{X } 100$$

Calculating the mean reliability scores for each session consisted of adding the reliability percentages for each trial and dividing by the total number of trials.

Rolling Mobilty

Reliability percentage for the number of complete rolls, degrees of body rotation, distance rolled and time elapsed from the beginning to the end of each trial were recorded separately. The initial position and direction of the roll were specified on the data sheet. Measures of duration were considered in agreement if the scores were within 5 seconds of each other. For each session across all trials, the number of agreements and the number of disagreements for the four categories were tallied, using the following formula to determine reliability scores;

$$\frac{\text{\# of agreements}}{\text{\# of agreements and disagreements}} \quad X\ 100$$

Calculating the mean reliability scores for each session consisted of adding the reliability percentages for each trial and dividing by the total number of trials.

Results

Interobserver reliability data and child performance data are presented in this section. The percents for segmental and mobility rolling are shown for each subject involved in the study.

Segmental Rolling - Reliability Results

The reliability scores for behaviors recorded in each session for Subject 1: Brian, Subject 2: Diane; and Subject 3: Rita, are presented in Table 1. These scores reflect excellent agreement for observations of the number of degrees rolled and the duration of the rolls both of which ranged from 92% to 100%. Reliability observations of the degrees of body rotation ranged from 58% to 100% with a mean reliability of 88%.

Table 1

Reliability Scores for Segmental Rolling

		Reliability Scores per Session			Mean Reliability Scores			
Subject	Session	Degrees of Body Rotation	Degrees Rolled	Duration	Degree of Body Rotation	Degrees Rolled	Duration	Total Mean Reliability
1	1	100	100	100	93	100	100	98
	2	94	100	100				
	3	85	100	100				
	4	92	100	100				
2	1	92	100	92	92	100	98	97
	2	75	100	100				
	3	100	100	100				
	4	100	100	100				
3	1	58	92	100	79	98	100	92
	2	67	100	100				
	3	100	100	100				
	4	92	100	100				
Mean Reliability for all subjects		88	99	99				

M(R)7

Mobility Rolling - Reliability Results

The reliability scores for behaviors recorded in each session for Subject 4 (Julie), are presented in Table 2. The reliability scores for the degrees of body rotation ranged from 88% to 100% with a mean of 97%. Reliability scores for the number of complete rolls ranged from 88% to 100% with a mean score of 97%. The distance rolled scores were all 100% with a mean score of 100%. Duration scores were all 100% with a mean score of 100%. The mean reliability for all four sessions was 97%.

Segmental Rolling - Performance Results

Subject 1. The segmental rolling for Subject 1 are illustrated in Figures 1 and 2. During the session one, Subject 1 rolled a miximum of six times out of a possible eighteen trials. The data indicate zero rolls from the prone position, two rolls from supine and four rolls from sidelying. The supine rolls were 180° to prone as the sidelying rolls were 90° to prone. As in session one, the majority of rolls in session two were from the supine to sidelying position: one, 180° roll from prone, three, 180° rolls from supine and four, 90° rolls from sidelying. The degrees of body rotation for all movement trials were between 0° and 22.5°. In session one, the mean duration of movement was twenty-one seconds when rolling from supine 180°, and six seconds when rolling from sidelying 90°. In session two the 180° rolls averaged thirteen seconds from supine and the 90° sidelying rolls averaged six and one half seconds. Session two had only one 180° roll in prone.

Table 2

Reliability Scores for Mobility Rolling

	Reliability Scores per Session					Mean Reliability Scores				
Subject	Session	Degrees of Body Rotation	# of Rolls	Distance	Duration	Degree of Body Rotation	# of Rolls	Distance	Duration	Total Mean Reliability
4	1	100	88	100	100	97	97	100	100	97
	2	100	100	100	100					
	3	100	100	100	100					
	4	88	100	100	100					

M(R)9

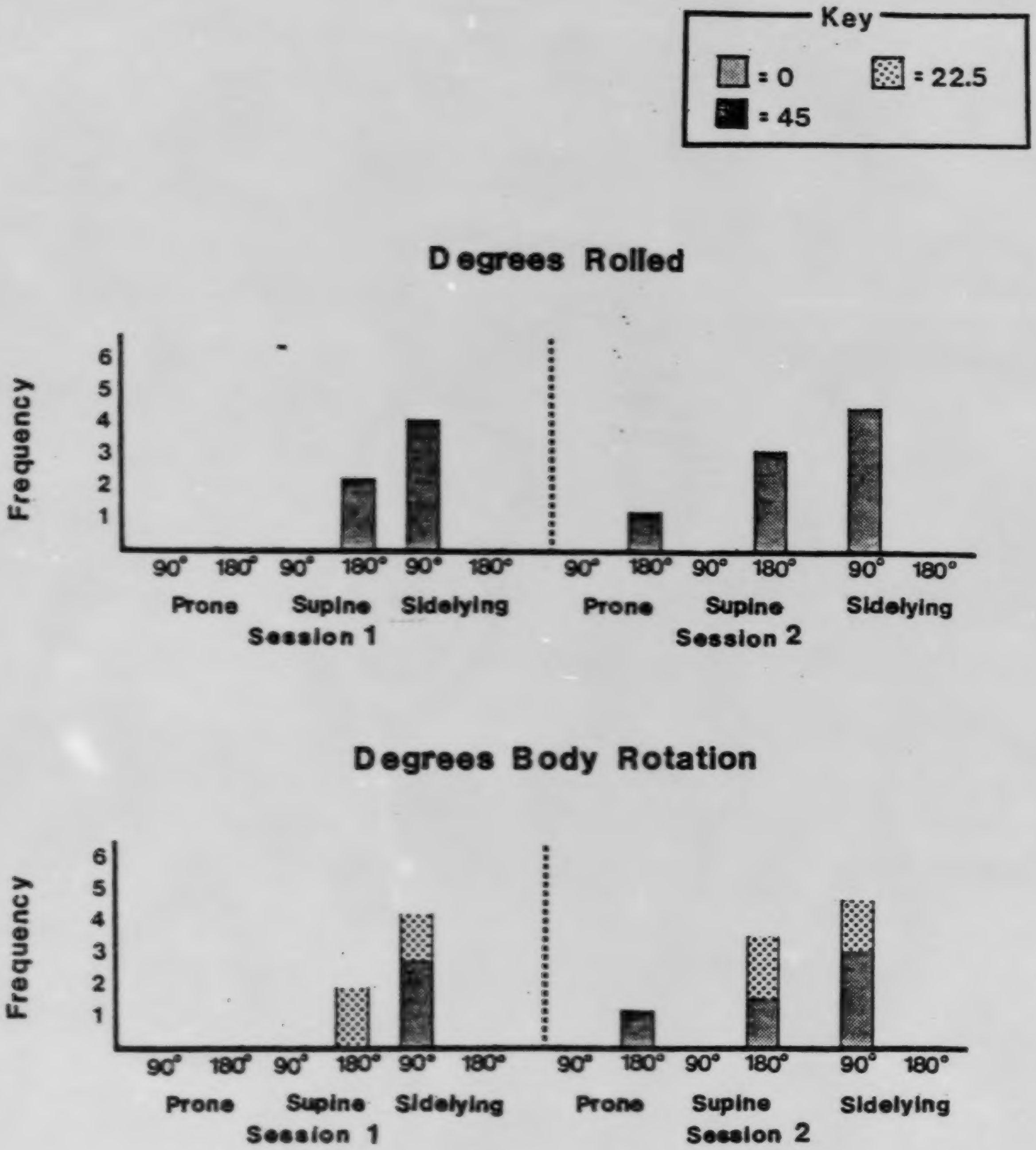
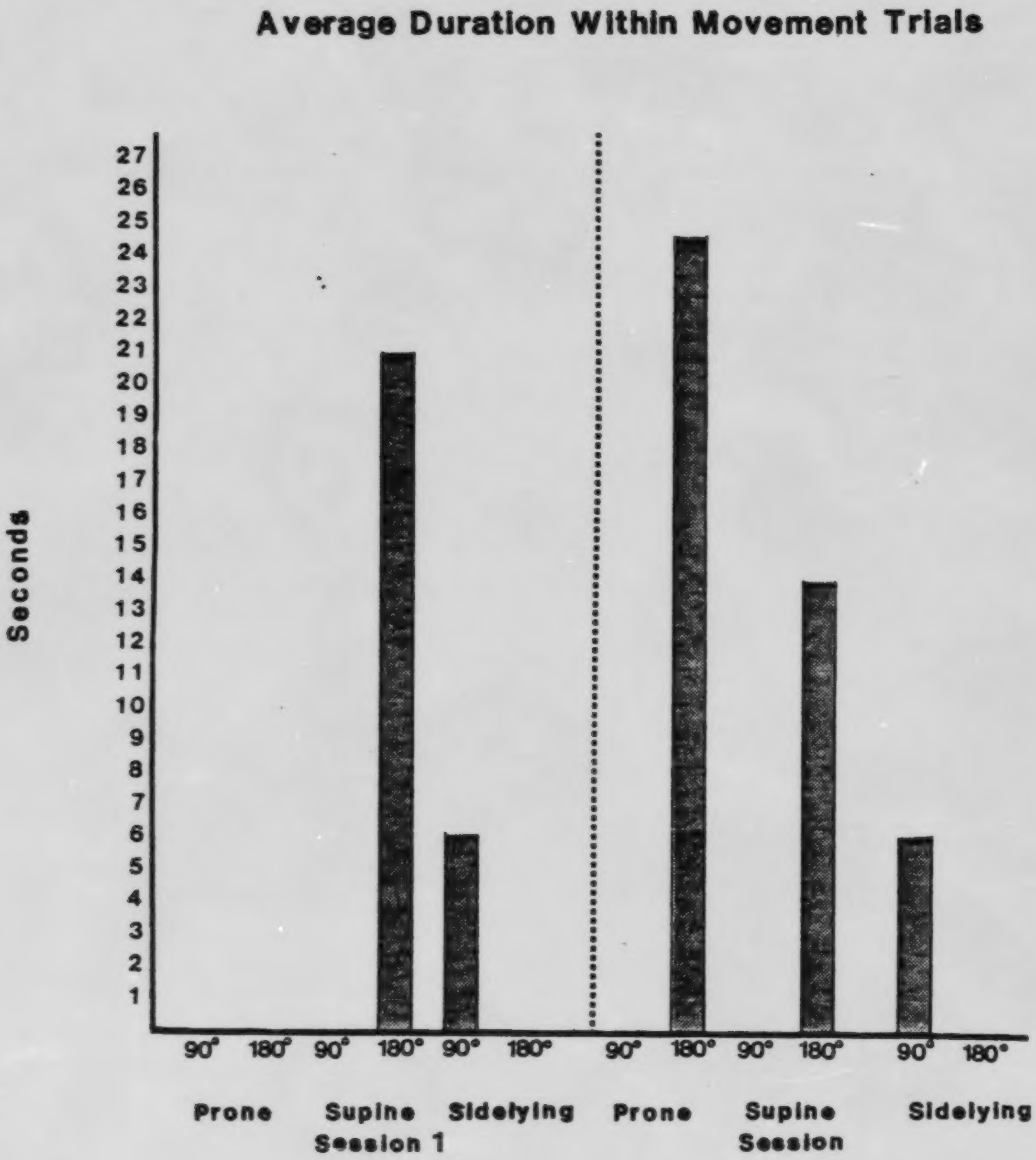


Figure 1 : Performance data for Subject 1 for degrees rolled, degrees of body rotation, and degrees of trunk rotation.



Average Duration Within Movement Trials

Figure 2: Performance data for Subject 1 for duration of movement.

Subject 2. Data for Subject 2 are illustrated in Figures 3 and 4. During session one, she rolled seven times out of a maximum twelve trials: one, 180° roll from prone and two, 90° rolls and three, 180° rolls from supine. As in session one, in session two the majority of rolls were from the supine position with zero rolls from prone and two-90° rolls and two-180° rolls from supine. The degrees of body rotation in the supine position ranged from 0° to 45°. In both sessions when the child rolled 90°, 22.5° of body rotation was noted whereas, when rolling from the supine position the degrees of body rotation was either 0° or 45°. Within a position, the average duration of movement for session one in the supine position was twenty-five seconds for 90° rolls and twenty-seven seconds for the 180° rolls. During session two the movement from supine averaged fifteen seconds when rolling 90° and four seconds when rolling 180°.

Subject 3. Data for Subject 3 are illustrated in Figures 5 and 6. During session one she rolled seven times out of a maximum twelve trials: four, 180° rolls from prone and three, 180° rolls from supine. In session two she also rolled a miximum of seven times with one,180° roll from prone and two, 90° rolls, and four, 180° rolls from the supine position. The degree of body rotation again ranged from 0° to 45°. During session one from prone to four-180° rolls indicated one roll with 0° of body rotation and two rolls with 45° of body rotation. In session two from the prone position the one, 180° roll was displayed with 22.5° of body rotation; from supine the two, 90° rolls exhibited 45° of body rotation and of the four, 180° rolls one was demonstrated with 22.5° of body rotation and three rolls with 45° of body rotation. The average duration from movement within a trial for session one was

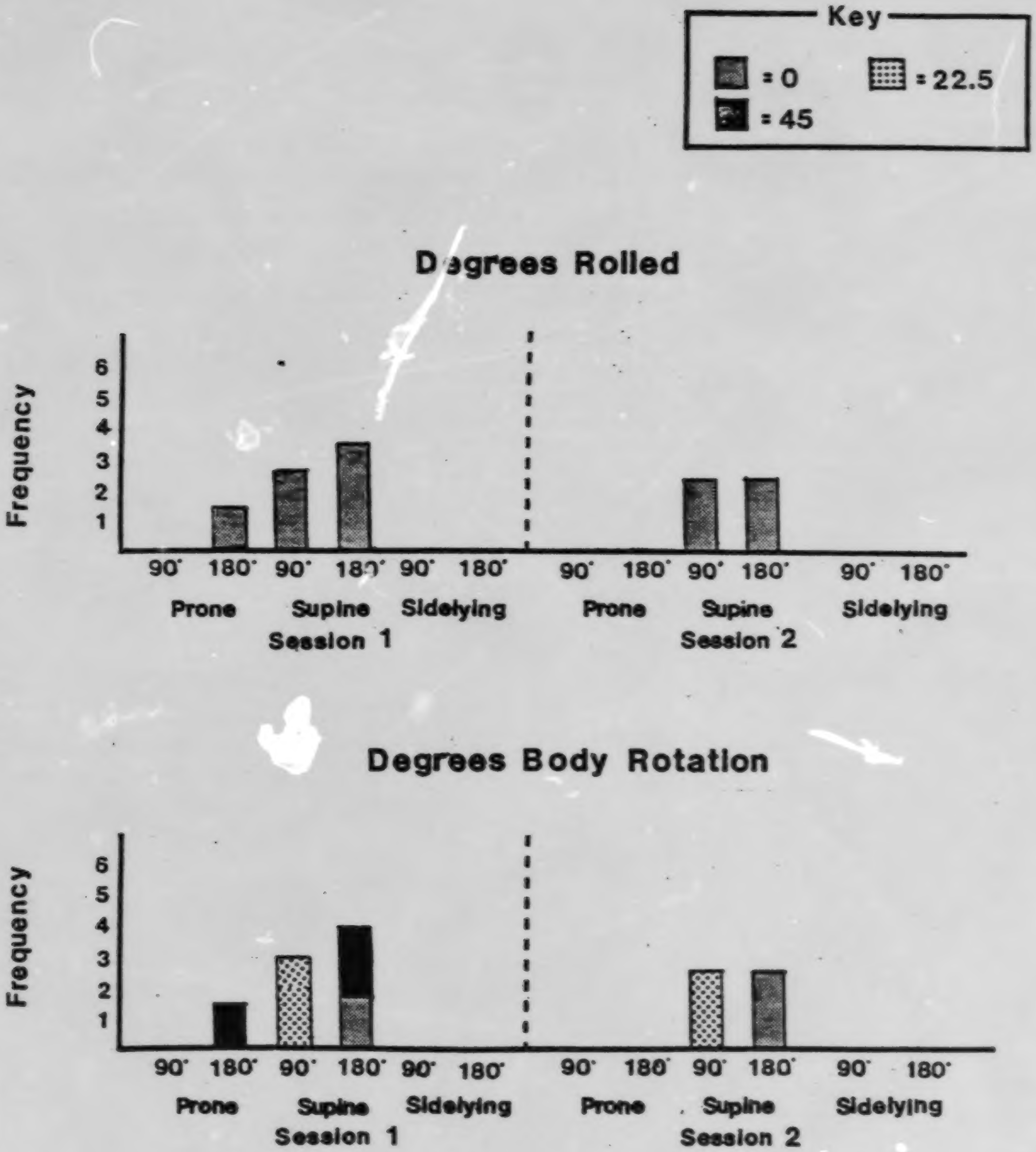


Figure 3: Performance data for Subject 2 for degrees rolled, degrees of body rotation, and degrees of trunk rotation.

Average Duration Within Movement Trials

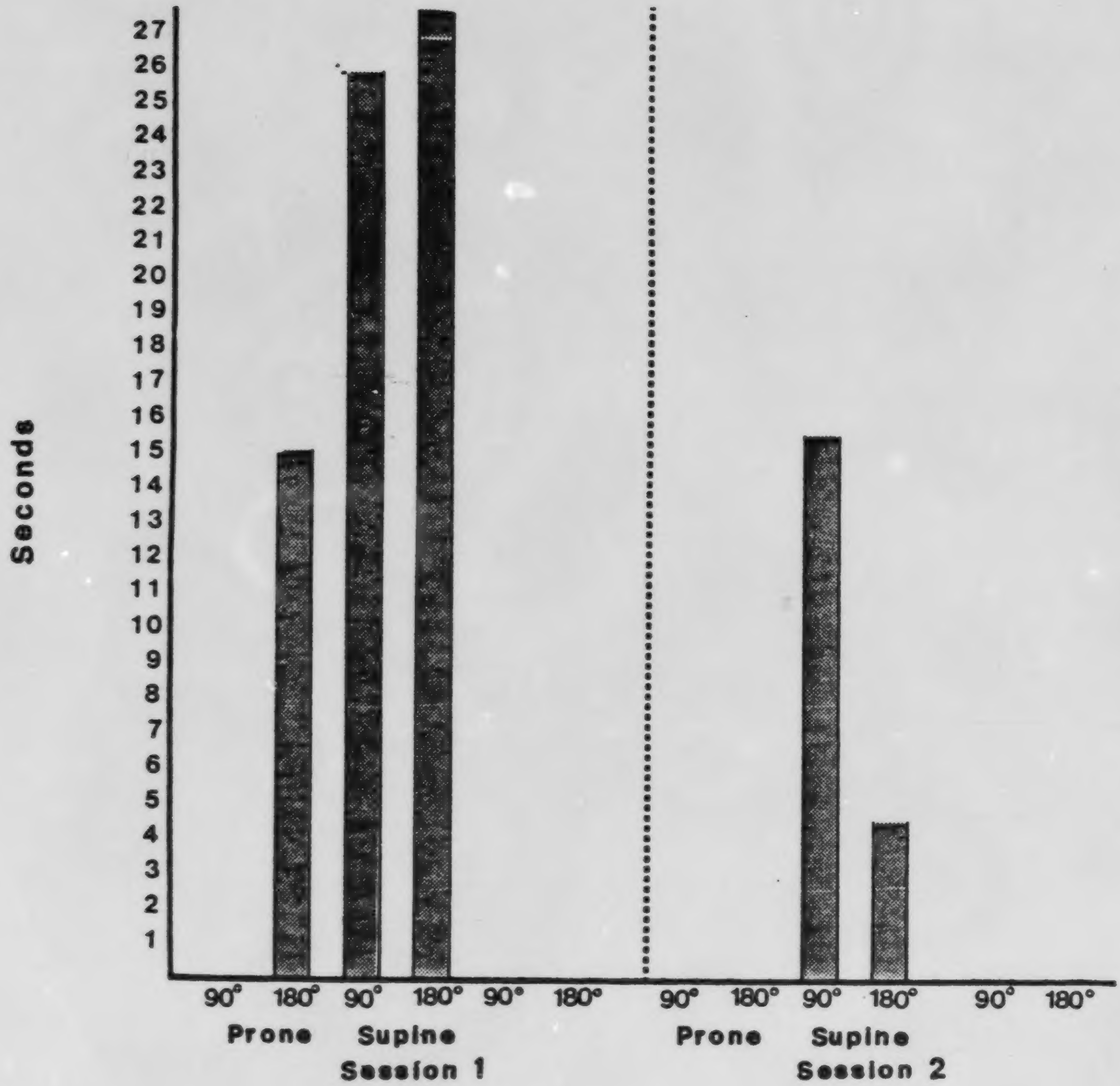


Figure 4: Performance data for Subject 2 for duration of movement.

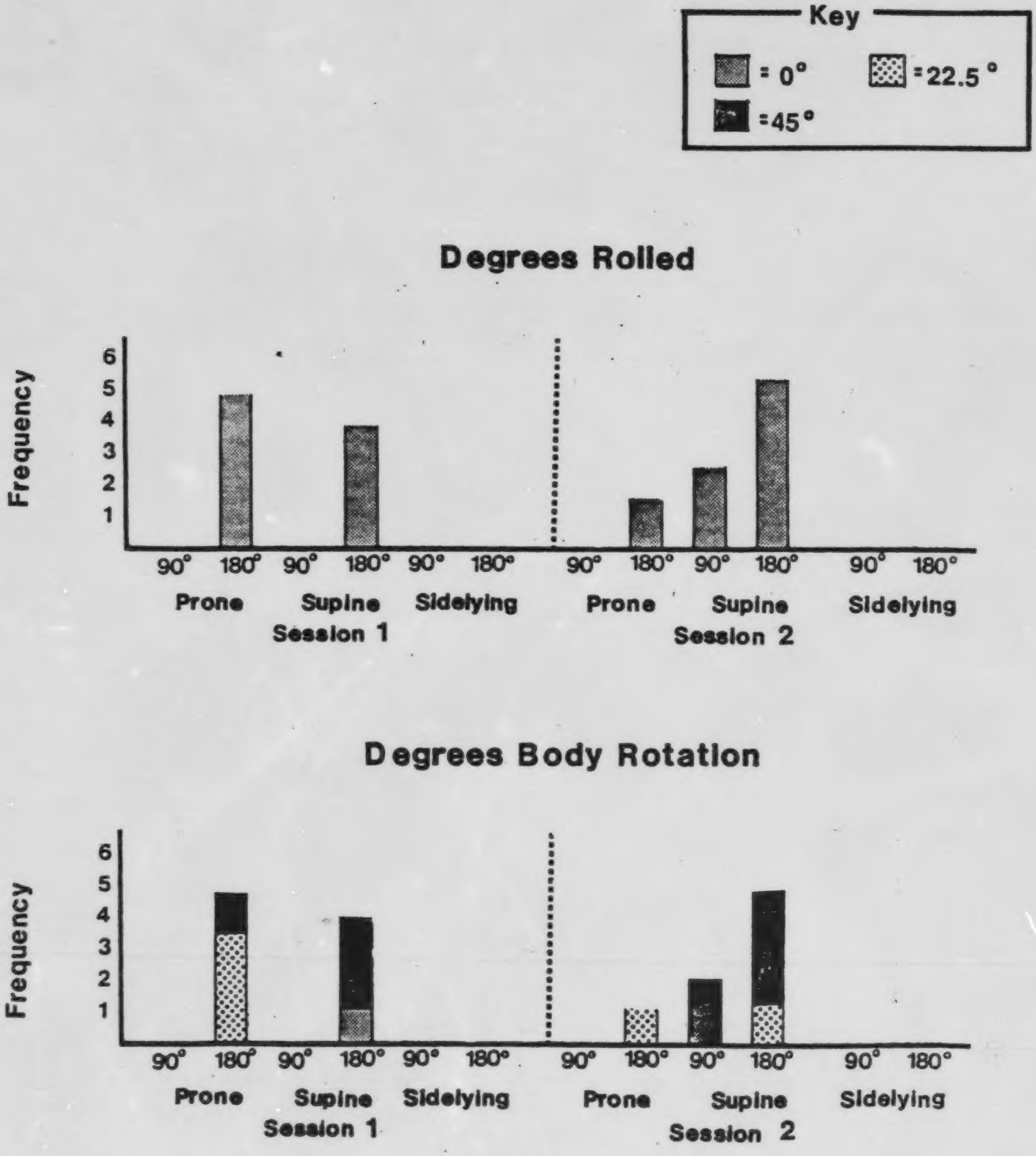


Figure 5: Performance data for Subject 3 for degrees rolled, degrees of body rotation, and degrees of trunk rotation.

Average Duration Within Movement Trials

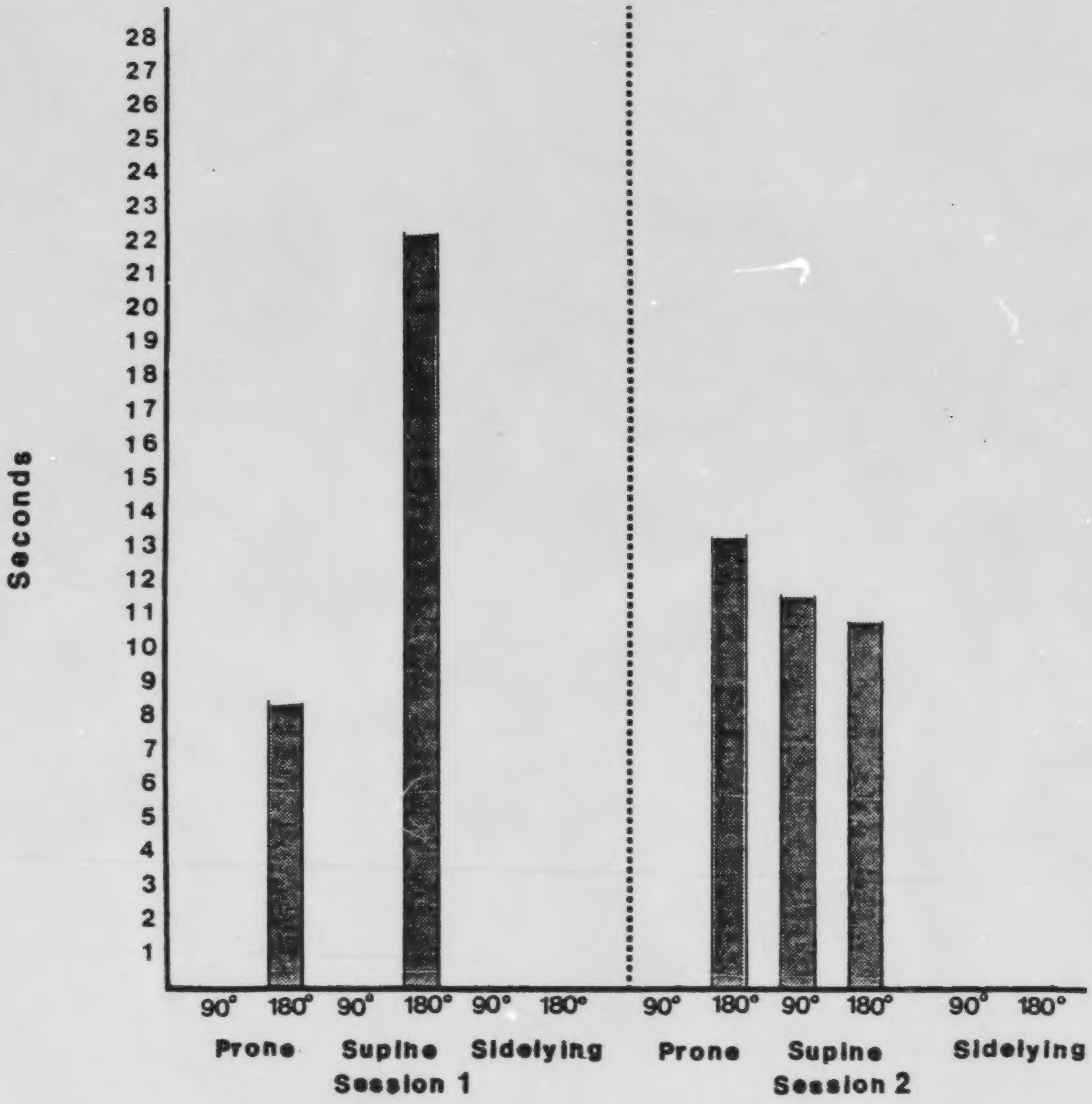


Figure 6: Performance data for Subject 3 for duration of movement.

from prone the 180° rolls averaged eight seconds and the 180° rolls from supine averaged twenty seconds. During session two, the movement from prone averaged thirteen seconds when rolling 180° and rolling from supine averaged eleven seconds when rolling 90° and ten and one half seconds when rolling 180°.

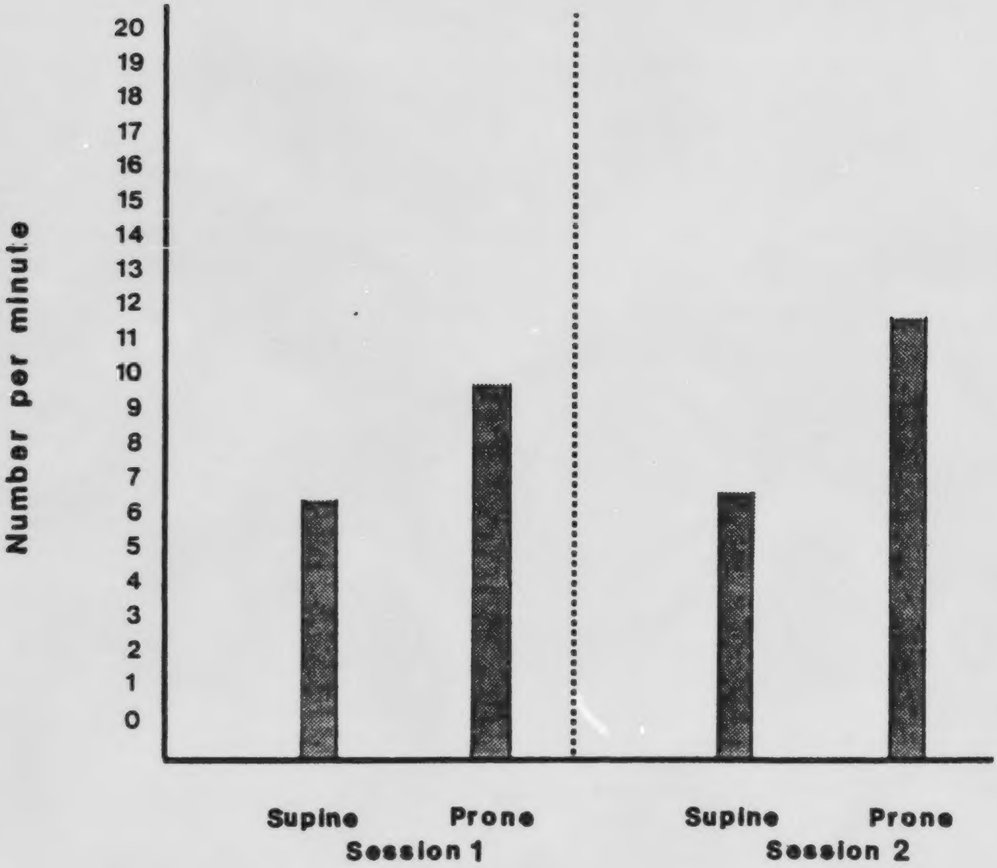
Rolling Mobility - Performance Results

Subject 4. Data for Rolling mobility for Subject 4 are illustrated in Figures 7 and 8. The mean number of rolls in the prone position ranged from 9.8 to 11.3 within a sixty second time period. Supine rolls ranged from a mean of 6.1 to 6.3. The mode degrees of body rotation in both the supine and prone positions was 0° and 22.5° for each session. The mean distance traveled in sixty seconds for the prone position ranged from 20 feet to 22.5 feet. In the supine position, the mean rate of movement was from 12.7 feet and 13 feet for the sessions.

Discussion

The reliability scores indicate that this measurement procedure provides a reliable method for measuring segmental rolling and rolling mobility. Several recommendations can be made, however which could serve to improve the reliability of the procedures. When reviewing the data for segmental rolling the degrees of body rotation displayed the lowest reliability scores. This was possibly due to the improper positioning of the examiner and observers and their subsequent difficulty in detecting the differences in alignment of the two elastic bands. Also, inaccuracies may have resulted because the elastic bands

Mean Number of Rolls Per Minute



Mode Degrees of Body Rotation

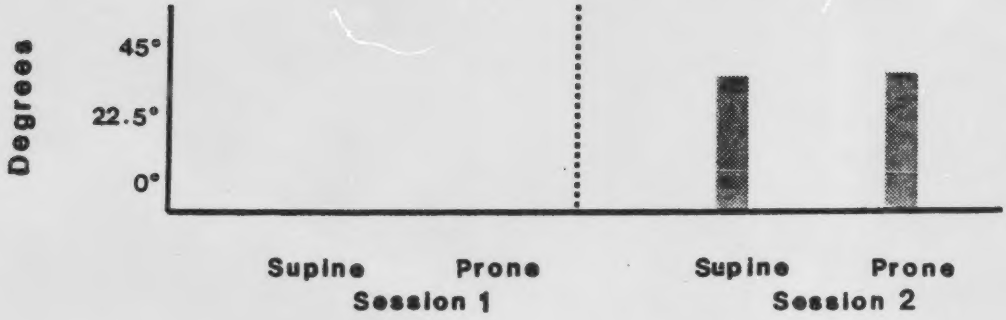


Figure 7 : Performance data for Subject 4 for number of rolls per minute and degree of body rotation.

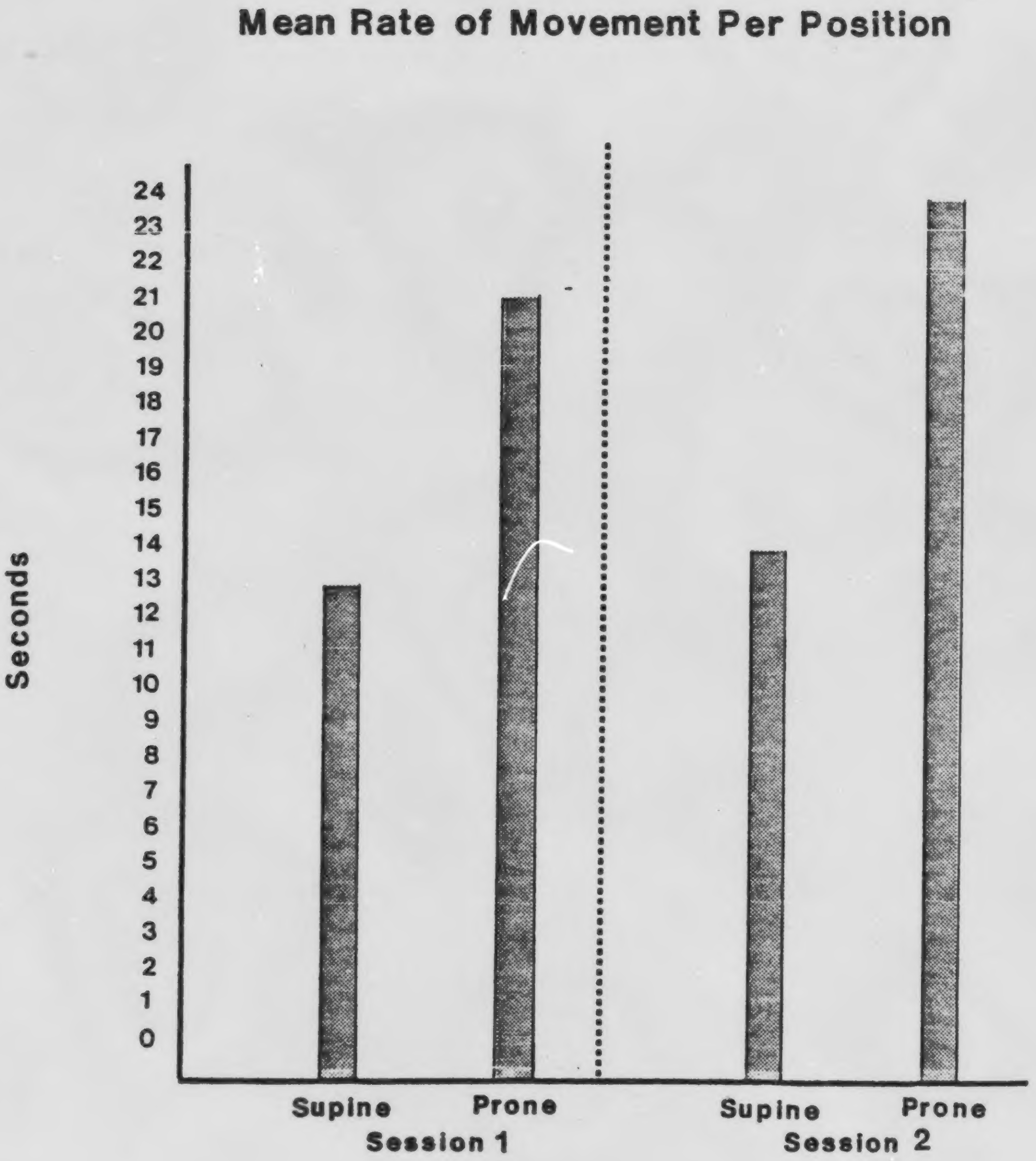


Figure 8 : Performance data for Subject4 for rate of movement by position.

were not securely attached to the child, thus requiring frequent repositioning after several trials.

The reliability scores for rolling mobility were consistently high, however only one subject was used to obtain reliability. It is essential that these procedures be replicated with more subjects to refine the procedures.

The observations were designed to be recorded during designated time periods, however frequently a child would exhibit the behavior between trials. In refining data collection procedures researchers may want to incorporate longer time trials in which to observe the behavior. The measurement procedures can be used to collect and analyze data gathered on both handicapped and non-handicapped children over a period of time. If data is collected for both handicapped and non-handicapped children in a longitudinal study this measurement procedure could explicate some of the similarities and differences between the two populations as relates to their development of the rolling behavior.

One example would be the earlier influence the neo-natal rolling may have on the subsequent development of rolling. as well as degrees of body rotation and its influence on the other areas of development.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE CRAWLING AND CREEPING BEHAVIORS AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results and Pilot Data with Two Nonhandicapped Infants and Six Handicapped Children[1]

by

Katherine Ann Kremer, Karen Leitner,
Donna Lehr, and Mary Jo Noonan

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[1] The procedures and data reported in this study were taken from Master's theses submitted to the Department of Special Education, University of Kansas, by Katherine Ann Kremer in October, 1979, and by Karen Leitner in August, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages M(C) 1 to M(C) 51 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring crawling and creeping were developed for the following three behaviors: maintenance, movement and locomotion.

Maintenance in the Position

The child was initially placed in the prone position for the first three trials of this procedure. The Assessment Administration Chart (see Figure 1) was then used after the first three trials to determine whether more trials were necessary. If more were needed, the chart further outlined the behaviors to be assessed, the initial position of the child at the beginning of each trial, and the cues that were to be used. Maintenance in the position was scored under three conditions: (1) a static crawling/creeping position; (2) movement in the position; and (3) locomotion in the position. During a one minute trial, a ten second momentary time sampling procedure was used to record the position of the child's arms and legs. The duration in which the child remained in a crawling and/or creeping position was also measured.

Movement in the Position

The child was positioned in either a prone, crawl, or creep position, depending upon the behavior demonstrated by the child when maintenance in the position was measured. Again, the number of trials, the cues, the initial position of the child, and the behaviors to be assessed were determined by the child's previous behaviors and could be found in the Assessment Administration Chart. The movements that were scored in this

STEP	DATA SHEET	TRIALS	BEHAVIOR TO ASSESS	CUES	CHILD RESPONSE	"✓" BEHAV.	NEXT STEP
1	1	1, 2, 3	Crawl or Creep	1, 2, 3	A) No maintenance in crawl or creep positions B) Maintain crawl position C) Maintain creep position		2 3 7
2	1	4, 5, 6	Crawling	4	A) No maintenance in crawl position B) Maintain crawl position		4 4
3	1	4, 5, 6	Creeping	4	A) No maintenance in creep position B) Maintain creep position		5 5
4	1	7, 8, 9	Creeping	4	A) No maintenance in creep position B) Maintain creep position		If previous response was 2A → STOP If previous response was 2B → 6 If previous response was 2A → 8 If previous response was 2B → 6
5	2	1, 2, 3	Crawling	1, 2, 3	A) Crawl rate < .1 step/sec. B) Crawl rate ≥ .1 step/sec.		If previous response was 3A → STOP If previous response was 3B → 9 If previous response was 3A → 10 If previous response was 3B → 9
6	2	1, 2, 3	Crawling	4	A) Crawl rate < .1 step/sec. B) Crawl rate ≥ .1 step/sec.		If previous response was 4A → STOP If previous response was 4B → 9 If previous response was 4A → 11 If previous response was 4B → 9
7	2	1, 2, 3	Creeping	1, 2, 3	A) Creep rate < .13 step/sec. B) Creep rate ≥ .13 step/sec.		STOP 12
8	2	1, 2, 3	Creeping	4	A) Creep rate < .13 step/sec. B) Creep rate ≥ .13 step/sec.		STOP 13
9	2	4, 5, 6	Crawling	4	A) Creep rate < .13 step/sec. B) Creep rate ≥ .13 step/sec.		If previous response was 5A → STOP If previous response was 5B → 10 If previous response was 6A → STOP If previous response was 6B → 11 If previous response was 5A → 13 If previous response was 5B → 10 If previous response was 6A → 13 If previous response was 6B → 11
10	3	1, 2, 3	Crawling	1, 2, 3			If previous response was 5A → STOP If previous response was 9A → STOP If previous response was 9B → 14
11	3	1, 2, 3	Crawling	4			If previous response was 6B → STOP If previous response was 9A → STOP If previous response was 9B → 14
12	3	1, 2, 3	Creeping	1, 2, 3			STOP
13	3	1, 2, 3	Creeping	4			STOP
14	3	4, 5, 6	Creeping	4			STOP

Figure 1. Assessment administration chart.

procedure were pivots, rocks, and steps for crawling behavior; and rocks and steps for creeping behavior. A frequency count was taken on each type of movement demonstrated for a total of one minute or ten feet, whichever came first. The duration recorded was either the length of time the child needed to travel ten feet or one minute, whichever came first. The rate of movement was also calculated, using the formula:

$$\frac{\text{\# of movements}}{\text{time}}.$$

Locomotion in the Position

This measurement procedure was not used unless the child achieved a minimum rate of movement (.1 step/sec.) on the second data sheet. The Assessment Administration Chart was also used with this procedure to determine the behaviors to be measured, the cues to be used, the number of trials needed, and the position in which the child was to be initially placed. This procedure consisted of recording the pattern of movement, that is, the order in which each of the various limbs moved. The distance the child traveled and the time it took to travel were also measured. When these were determined, the rate of movement was calculated as follows: $\frac{\text{distance}}{\text{time}}$. The trials were two minutes in length or ten feet, whichever came first.

Subjects

Two non-handicapped infants and six multiply handicapped children were studied. The handicapped children were from the Capper Foundation and Sheldon School, both in Topeka, and the Preschool at the University of Kansas. These children were selected because they demonstrated behaviors related to creeping and crawling, which included either maintenance, movement or locomotion in the position.

Leitner (1980) used 3 handicapped and 1 non-handicapped child to obtain data on the crawling assessment.

Subject 1. Marc was a four year old male with spastic quadriparesis and a severe developmental delay in motor development, with more involvement on the left side. Marc was functioning below the six month level on the motor development section of the Callier Azusa Scale (Stillman, 1978).

Subject 2. Steven was a six year old male with spastic quadriparesis. According to the motor section of the Callier Azusa Scale he was functioning below the six month level.

Subject 3. Mike was a six year old male with spastic quadriparesis and a severe developmental delay. According to the motor development section of the Callier Azusa Scale he was functioning around the six month level.

Subject 4. Megan, the nonhandicapped subject in this study, was a seven month old infant who was developing within normal limits.

Four children, three handicapped and one non-handicapped, were the subjects for the creeping assessment (Kremer, 1979).

Subject 1. Pat was a thirteen year old severely, multiply handicapped blind male, with spastic quadriparesis. He demonstrated extensor tone most of the time and was unable to roll or sit independently. He was capable of propping on forearms in the crawling position, but could not independently get into the creeping position. Once positioned, he was able to maintain it for short periods at a time.

Subject 2. John was a severely, physically handicapped five year old male with spastic quadriparesis. He was able to roll and side sit independently, but demonstrated abnormal crawling patterns. He could maintain and rock in a creeping position after being placed into the position.

Subject 3. Gary was a four year old male with spastic quadriparesis and was developmentally delayed. He demonstrated independent rolling and side-sitting behaviors. When placed in the prone position, he was able to get into the creeping position by himself and then locomote, with some abnormal tone present.

Subject 4. David was a nine month old normally developing male infant. His repertoire of behaviors included rolling, circle sitting, pulling to stand, and independently getting into the creeping position.

Procedures for Obtaining Measures of Reliability

Reliability measures were taken from direct observation of three multiply handicapped children and one nonhandicapped child in each study. In Leitner's study, the observers taking reliability were the investigator, the author's husband, a special education teacher, one parent and two teaching assistants. The investigator, a special education teacher, two graduate students in special education, and one teaching assistant observed for reliability in Kremer's study.

Three criteria were established for taking measures of reliability: (1) two observers, one trained and one naive, were required to collect data on every session; (2) the reliability scores could be no lower than 80% for any session; and (3) 80% criterion had to be met for two consecutive sessions with the same two observers. If criterion was not met on the second session, then both sessions were repeated.

Maintenance in the Position

Reliability measures for this procedure were obtained on all four leg and arm position recordings. Separate reliability scores were calculated for leg positions and for arm positions. The number of agreements and the number of disagreements between two observers for the children's leg positions were totaled for each session across all trials. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to obtain the reliability percentage of each session. The formula is as follows:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \quad \text{X } 100.$$

The mean reliability score for legs across all sessions was then determined by adding together all the reliability scores from each session and dividing by the total number of sessions. The same procedures were used for obtaining reliability scores for the arm positions.

Duration recordings. The reliability percentages for each session across all trials were determined by dividing the larger duration number into the smaller duration number and multiplying by 100. The average reliability score for the four sessions was obtained by adding together all the percentage scores from each session and dividing by the total number of sessions.

The mean reliability for all the subjects across all sessions was calculated for leg positions, arm positions, and duration. The scores for the leg positions from every session and from every child were added together and then divided by the total number of percentages. The same process was applied in calculating the mean reliability for all children on all sessions for arm positions and duration.

The mean reliability score for each child across all sessions and all behaviors was also calculated. This was obtained by adding together reliability scores from every session for each behavior and dividing by the total number of scores from all four sessions.

Movement in the Position

Reliability measures were only taken on children demonstrating movement in the position.

Movement recordings. Reliability percentages for each type of movement (pivots, rocks in crawling, rocks in creeping, steps in crawling, and steps in creeping) were recorded separately. For each session across all trials, the number of agreements and the number of disagreements for each type of movement were tallied using the following formula to determine reliability scores:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \quad \text{X } 100.$$

Calculating the mean reliability scores across sessions for each movement consisted of adding the reliability percentages for each movement and dividing by the total number of sessions.

Duration recordings. The reliability scores for duration of movement in each session were determined by dividing the smaller duration number by the larger duration number and then multiplying that number by 100. By adding together the percentages from all the sessions and dividing by the total number of sessions, the mean reliability score across all sessions for each child was obtained.

The mean reliability score for all subjects across all sessions was obtained by adding together all the percentages from all the sessions for every child and dividing that number by the total number of percentages from all the sessions of every child.

The mean reliability scores for each subject across all sessions and all behaviors were determined by adding together the percentages from all sessions for the various types of movements for both crawling and creeping as well as the reliability scores for duration. This number was then divided by the total number of percentages from all sessions.

Locomotion in the Position

Reliability measures for locomotion were only obtained on children that were locomoting in the crawling or creeping position.

Pattern recordings. The number of agreements and the number of disagreements were recorded for each session. Agreements and disagreements were determined by comparing Observer 1's data against Observer 2's data using a sliding criterion method. If the numbers in the pattern matched, they were considered agreements; but if Observer 2 had different numbers, not enough numbers, or too many numbers when compared to Observer 1, then these were counted as disagreements. If Observer 2 did not have enough numbers or too many numbers, then the pattern of Observer 2 "slid" up or back in order to better match Observer 1's data. The following example illustrates this method. The "+" above the numbers denotes agreements, while the "-" signifies disagreements:

Observer 1's Data: 3-4-3-4-2-3-1-3-2-3-2-3-2-3-1-4-2

Observer 1's Data: 4-3-4-2-3-1-4-2-3-2-3-1-4

Observer 2's data will "slide up" one number since Observer 2 is missing the first "3" as follows:

Observer 1's Data: 3-4-3-4-2-3-1-4-2-3-2-3-^ 2-3-1-4-2

Observer 2's Data: 4-3-4-2-3-1-4-2-3-2-3- 1-4

The pattern only matches up to point A. After point A, there is a disagreement in the numbers. Observer 2's pattern may then slide back so that the "1-4" matches:

- + + + + + + + + + + + - - + + -

Observer 1's Data: 3-4-3-4-2-3-1-4-2-3-2-3-2-3-1-4-2

Observer 2's Data: 4-3-4-2-3-1-4-2-3-2-3- 1-4

Therefore, the total number of agreements would be 13 and the total disagreements would be 4. However, if this were the beginning and end of a trial, the first "3" and the last "2" would not be considered disagreements. Three or fewer numbers at the beginning or end of a trial may be deleted because both Observers may not begin to record at the same time.

The total number of agreements were divided by the total number of agreements plus disagreements and multiplied by 100 to obtain the reliability score for each session across trials. The mean reliability percentage of all sessions was obtained by adding together the percentage scores from each session and dividing by the total number of sessions.

Percentage scores from each session for both subjects were added together and divided by the total number of sessions to obtain the average reliability percentage for all sessions and for both subjects.

Results

Interobserver reliability scores for behaviors recorded on all six data sheets are presented in this section. The data include the scores for behaviors recorded in each session for each child; the mean reliability scores for all sessions for each child; and the overall mean reliability scores for all children. Tables 1, 3, and 5 contain the data collected by Leitner (1980) for measuring crawling behavior. Tables 2, 4, and 6 include the reliability scores obtained in Kremer's study (1979) for measuring creeping behavior.

Maintenance in the Position

For the crawling study, the reliability scores for each session for the three handicapped children (Subject 1: Marc; Subject 2: Steven; Subject 3: Mike) and the non-handicapped infant (Subject 4: Megan) are found in Table 1. Better reliability scores were obtained for leg positions (95%) than for arm positions (91%). Except for the arm positions of Mike (Subject 3) and Megan (Subject 4), the mean reliability scores for leg and arm positions for each session for each child were above 90%. Duration reliability scores for every session were all 100%.

Table 2 contains the data for the creeping study collected on the three handicapped children (Subject 1: Pat; Subject 2: John; Subject 3: Gary) and the non-handicapped infant (Subject 4: David). These data also indicate better reliability for leg positions (93%) than for arm positions (91%). Except for John (Subject 2), all the mean reliability scores for each child across all sessions for leg and arm positions were above 90%. The mean reliability scores for duration across all sessions were above 93%.

Movement in the Position

In Table 3, reliability data for all four children in the crawling study are presented. The mean reliability for all four sessions together for pivoting ranged from 80% to 98%. The mean reliability for crawling steps across the four sessions varied from 87% to 96%. Only the non-handicapped infant (Michael, Subject 4) demonstrated creeping rocks for two sessions which had an 88% mean reliability score. The reliability scores for duration were 100% in every session for every child.

Table I

Reliability Scores for Data Sheet #1, Crawling Study

Maintenance in the Position

Subject	Reliability Scores per Session				Mean Reliability Scores			Mean Reliability Scores for all Sessions
	Session	Legs	Arms	Duration	Legs	Arms	Duration	
1	1	100	95	100	95	92	100	95
	2	100	100	100				
	3	92	87	100				
	4	89	89	100				
2	1	100	100	100	99	93	100	97
	2	97	100	100				
	3	100	89	100				
	4	100	83	100				
3	1	100	85	100	100	89	100	96
	2	100	85	100				
	3	100	97	100				
	4	100	91	100				
4	1	84	83	100	91	89	100	93
	2	83	95	100				
	3	100	86	100				
	4	100	93	100				
Mean Reliability for all Subjects		95	91	100				95

M(C)12

Table 2

Reliability Scores for Data Sheet #1, Creeping Study: Maintenance in the Position

M(C)13

	Reliability Scores per Session				Mean Reliability Scores			Mean Reliability Scores for all Sessions
Subject	Session	Legs	Arms	Duration	Legs	Arms	Duration	
1	1	100	86	100	95	92	95	94
	2	86	97	80				
	3	92	95	100				
	4	100	89	100				
2	1	83	83	100	87	83	94	88
	2	94	89	100				
	3	83	86	83				
	4	89	72	93				
3	1	100	92	100	94	97	100	97
	2	94	97	100				
	3	83	100	100				
	4	100	100	100				
4	1	92	83	100	95	91	96	94
	2	100	100	100				
	3	94	86	83				
	4	94	95	100				
Mean Reliability for all Subjects		93	91	96				93

Table 3

Reliability Scores for Data Sheet #2, Crawling Study:

Movement in the Position

		Reliability Scores per Session					
		Crawling			Creeping		
Subject	Session	Pivots	Rocks	Steps	Rocks	Steps	Duration
1	1	-	-	92	-	-	100
	2	-	-	94	-	-	100
	3	-	-	92	-	-	100
	4	-	-	87	-	-	100
2	1	100	-	100	-	-	100
	2	83	-	97	-	-	100
	3	100	-	96	-	-	100
	4	100	-	91	-	-	100
3	1	-	-	82	-	-	100
	2	60	-	80	-	-	100
	3	-	-	94	-	-	100
	4	100	-	100	-	-	100
4	1	100	-	-	77	-	100
	2	92	-	-	-	-	100
	3	100	-	-	-	-	100
	4	100	-	87	100	-	100
Mean Reliability Scores							
1		-	-	91	-	-	100
2		96	-	96	-	-	100
3		80	-	89	-	-	100
4		98	-	87	88	-	100
Mean Reliability for all Subjects							
		91		91	87		100

M(C)14

In the reliability scores collected for measuring creeping behavior (see Table 4), only one child, John (Subject 2) demonstrated crawling pivots and 0% reliability was obtained for both sessions. Again, John was the only child for which data were collected on creeping rocks. The reliability scores for each session were about 90%. Data for creeping steps were only collected on Gary and David (Subjects 3 and 4) and the reliability scores in each session were all 90% or above. Each child had better than a 90% mean reliability score across all four sessions. For the duration measure, the mean reliability scores for all four sessions for each child ranged from 94% to 100%.

Locomotion in the Position

Data were obtained on only the three handicapped children in the study for measuring crawling behavior and can be found in Table 5. The mean reliability scores across four sessions for each child ranged from 86% to 93%.

Table 6 presents reliability scores gathered in the study measuring creeping behavior for Gary and David, the two children for which locomotion data were recorded. The mean reliability scores across four sessions for each child were 85% and 91%.

Combined Performance Data for the Eight Children

The performance scores varied with each data sheet. In both studies, data sheet #1 included percent scores for all four sessions combined for each subject. Modal scores were also determined for the total four sessions. Scores for data sheets #2 and #3, for both the creeping and the crawling study, were included for each trial and then the mean scores for each session were calculated.

Table 4

Reliability Scores for Data Sheet #2, Creeping Study: Movement in the Position

		Reliability Scores per Session						
		Crawling			Creeping			Mean Reliability Score for all Sessions
Subject	Session	Pivots	Rocks	Steps	Rocks	Steps	Duration	
2	1	-	-	88	100	-	100	82
	2	0	-	96	96	-	100	
	3	0	-	96	91	-	100	
	4	-	-	82	97	-	100	
3	1	-	-	-	-	99	99	97
	2	-	-	-	-	94	95	
	3	-	-	-	-	98	97	
	4	-	-	-	-	93	99	
4	1	-	-	-	-	90	97	96
	2	-	-	-	-	96	94	
	3	-	-	-	-	99	99	
	4	-	-	-	-	99	94	
Mean Reliability Scores								
2		0	-	91	96	-	100	
3		-	-	-	-	96	98	
4		-	-	-	-	96	96	
Mean Reliability for All Subjects								
		0	-	91	96	96	97	

Table 5

Reliability Scores for Data Sheet #3, Crawling Study:

Locomotion in the Position

Reliability Scores per Session			Mean Reliability Scores	Mean Reliability Score for all Sessions
Subject	Session	Pattern		
1	1	82	86	89
	2	83		
	3	95		
	4	94		
2	1	94	93	
	2	89		
	3	90		
	4	88		
3	1	87	88	
	2	84		
	3	96		
	4	86		

Table 6

Reliability Scores for Data Sheet #3, Creeping Study: Locomotion in the Position

Reliability Scores per Session			Mean Reliability Scores	Mean Reliability Score for all Sessions
Subject	Session	Pattern		
1	1	82	85	89
	2	83		
	3	90		
	4	86		
2	1	82	91	
	2	92		
	3	90		
	4	100		

Maintenance in the Position. Performance data for maintenance in the position were obtained on all four children for each study. The percentages indicate the frequency that each leg and arm position were demonstrated by the child for both the left and the right side out of a possible 72 times. Seventy-two is the total number of observations for all four sessions and therefore the maximum number of times the behavior could have been demonstrated. Total duration represents the time the child was in position for all four sessions. Raw data scores for all four children in the crawling study are presented in Appendix A. Appendix B contains the scores for the children in the creeping study.

Figures 2 through 9 include the performance data for the study of crawling behavior. The "props on forearms," "arms extended," and "out of position" were the arm positions most frequently observed. Steven (Subject 3) demonstrated the most consistent responding, "props on forearms," for 80% and 52% of the trials for the left and right arms respectively. The "out of position response" was the most frequent response for two of the children, Marc (Subject 1) and Megan (Subject 4). The most frequent leg position responses for all four children were "leg flexed up," "leg extended passive," and "out of position." "Leg extended passive" was the most frequent response for all of the children except Marc (Subject 1). Steven (Subject 3) maintained the position the longest, 92% of the time; Michael (Subject 4) maintained the position the shortest, 63% of the time.

The performance data for the study of creeping behavior can be graphically seen in Figures 10 through 17. The most frequent arm position responses for all four subjects were "arms extended," "props

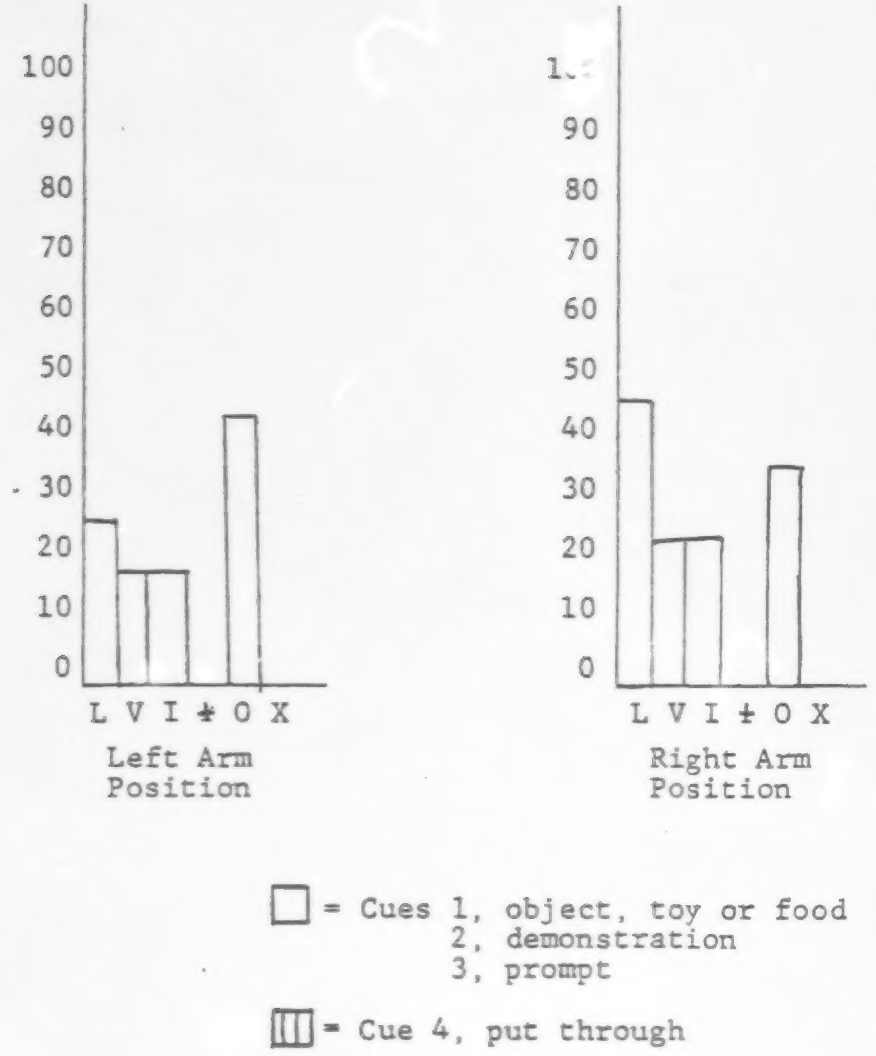


Figure 2. Marc's arm positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

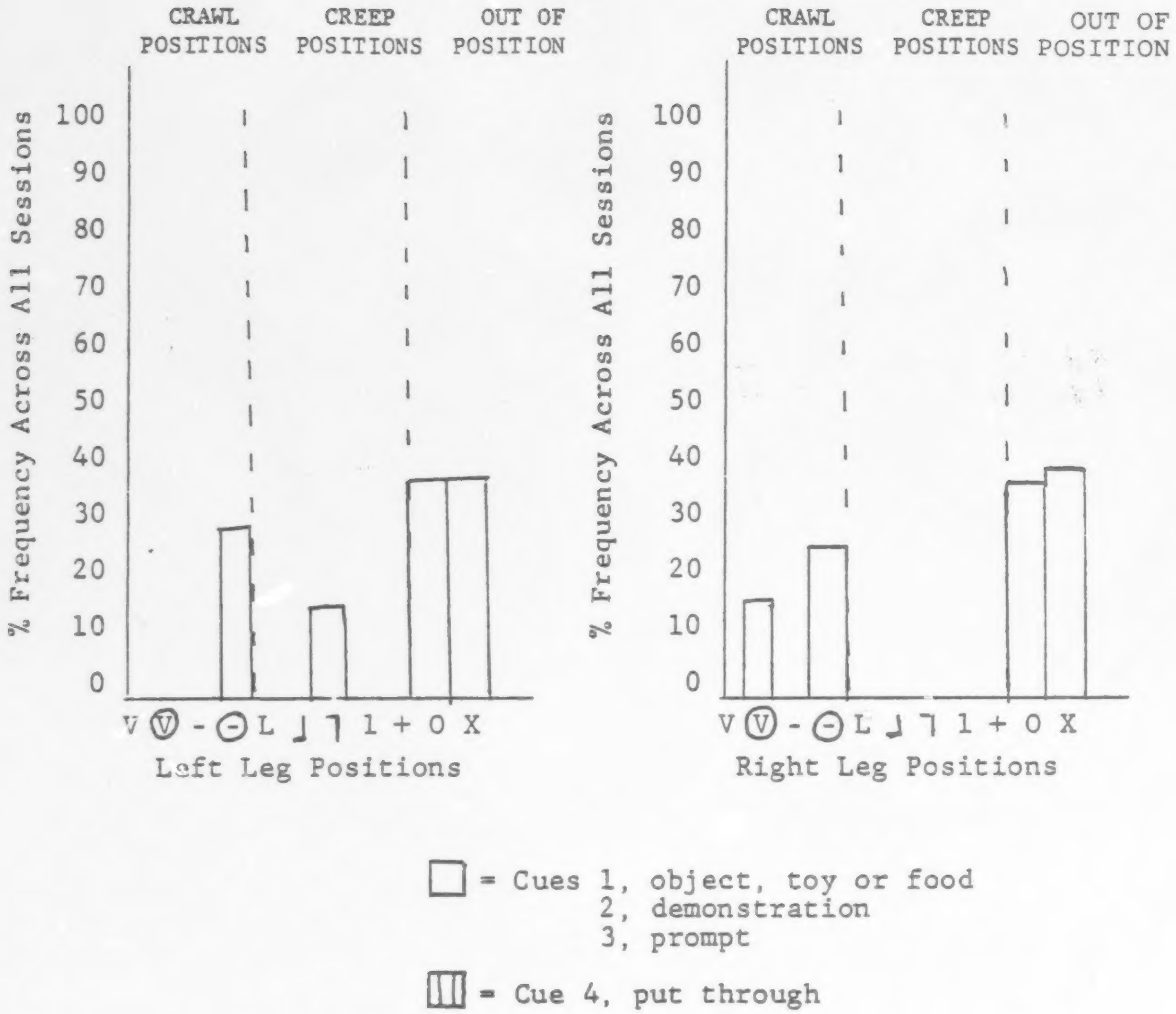


Figure 3. Marc's leg positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

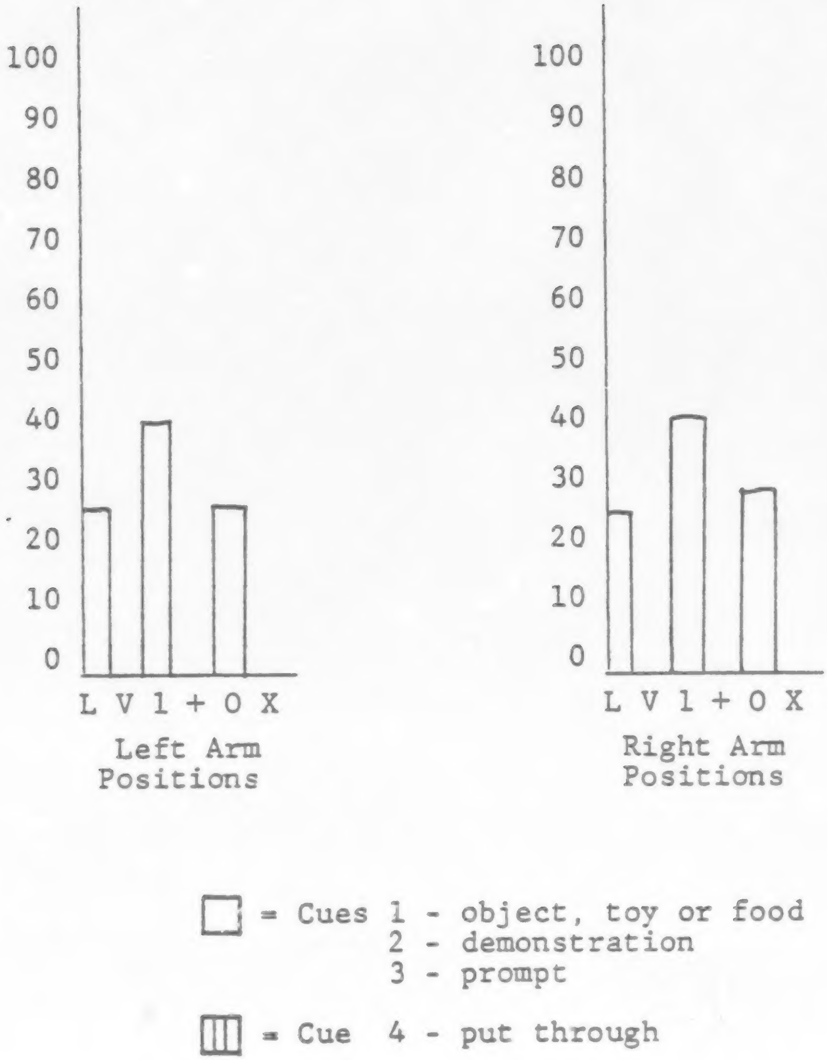


Figure 4. Megan's arm positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

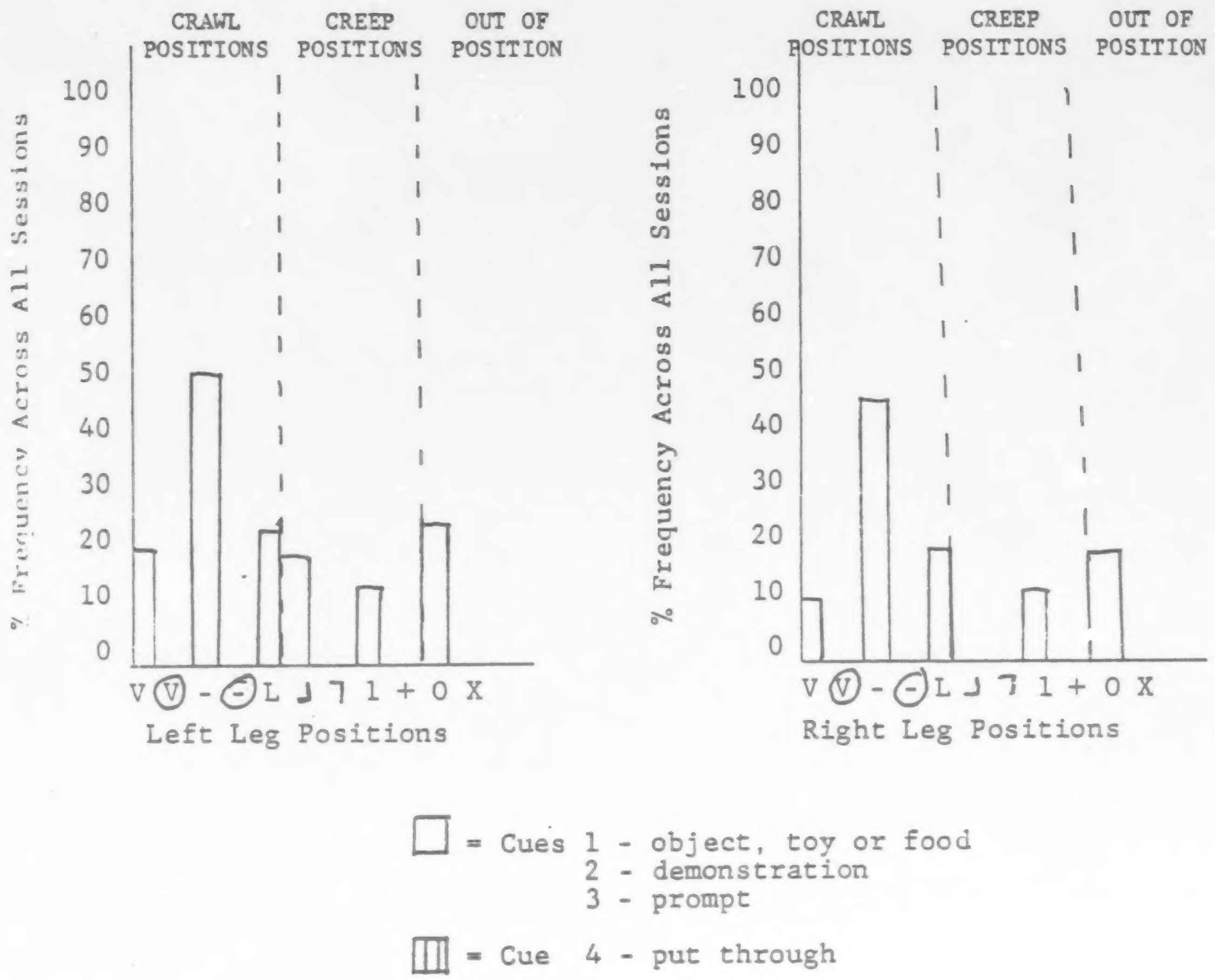


Figure 5. Megan's leg positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

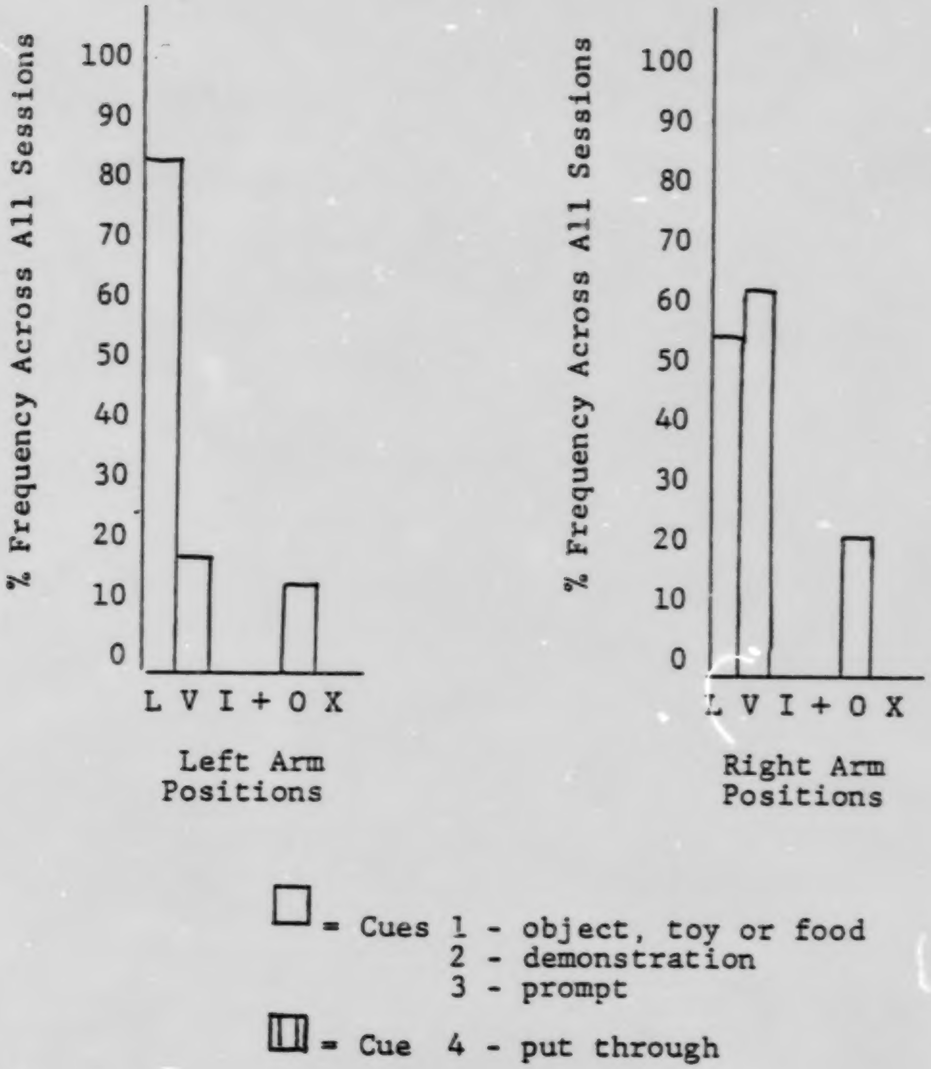


Figure 6. Steven's arm positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

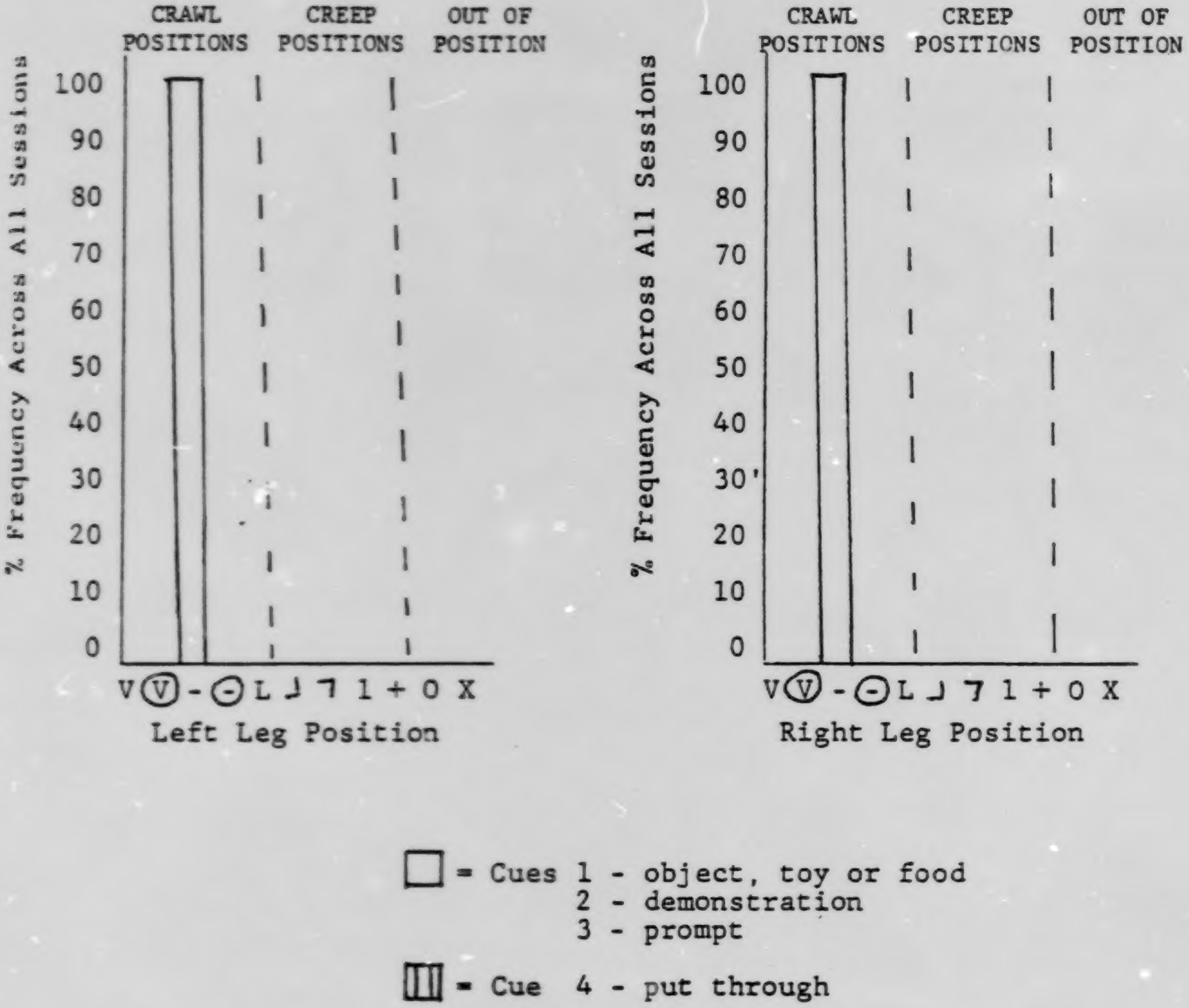


Figure 7. Steven's leg positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

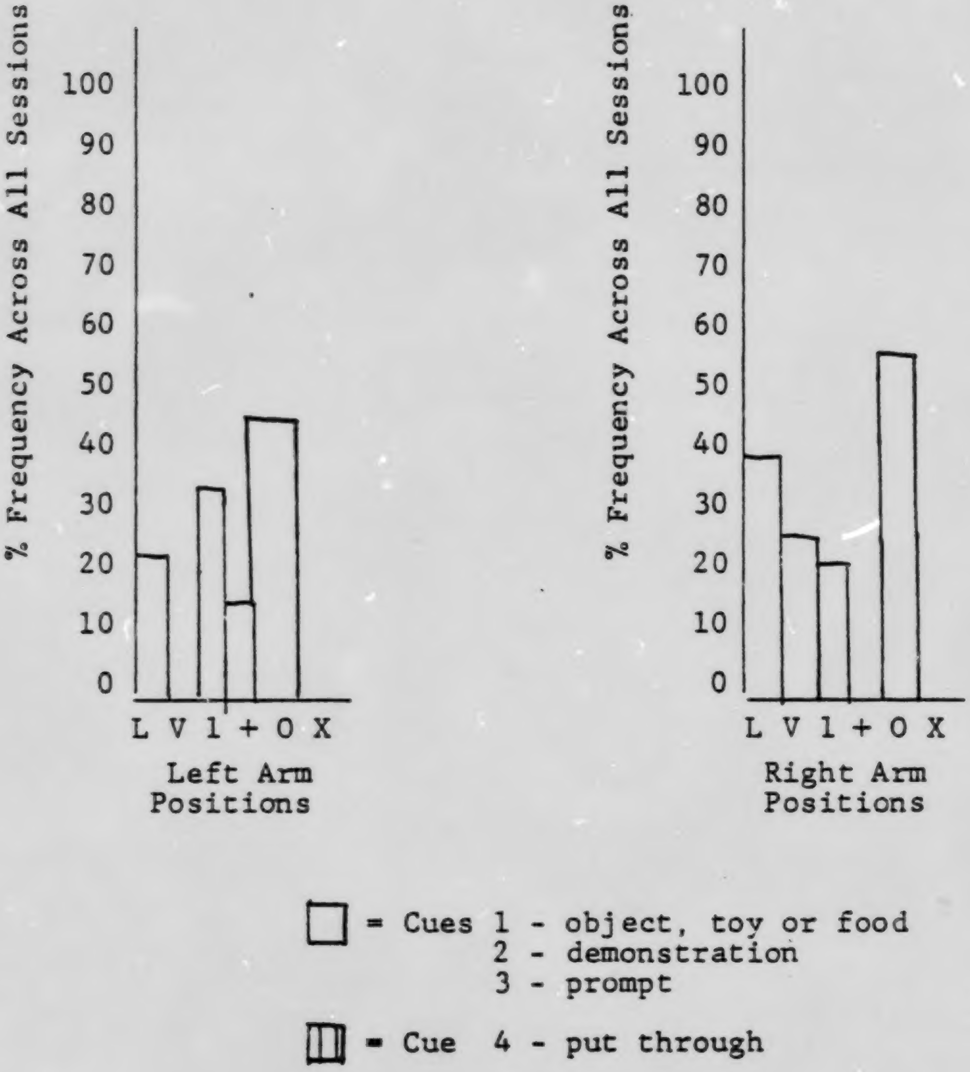


Figure 8. Michael's arm positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

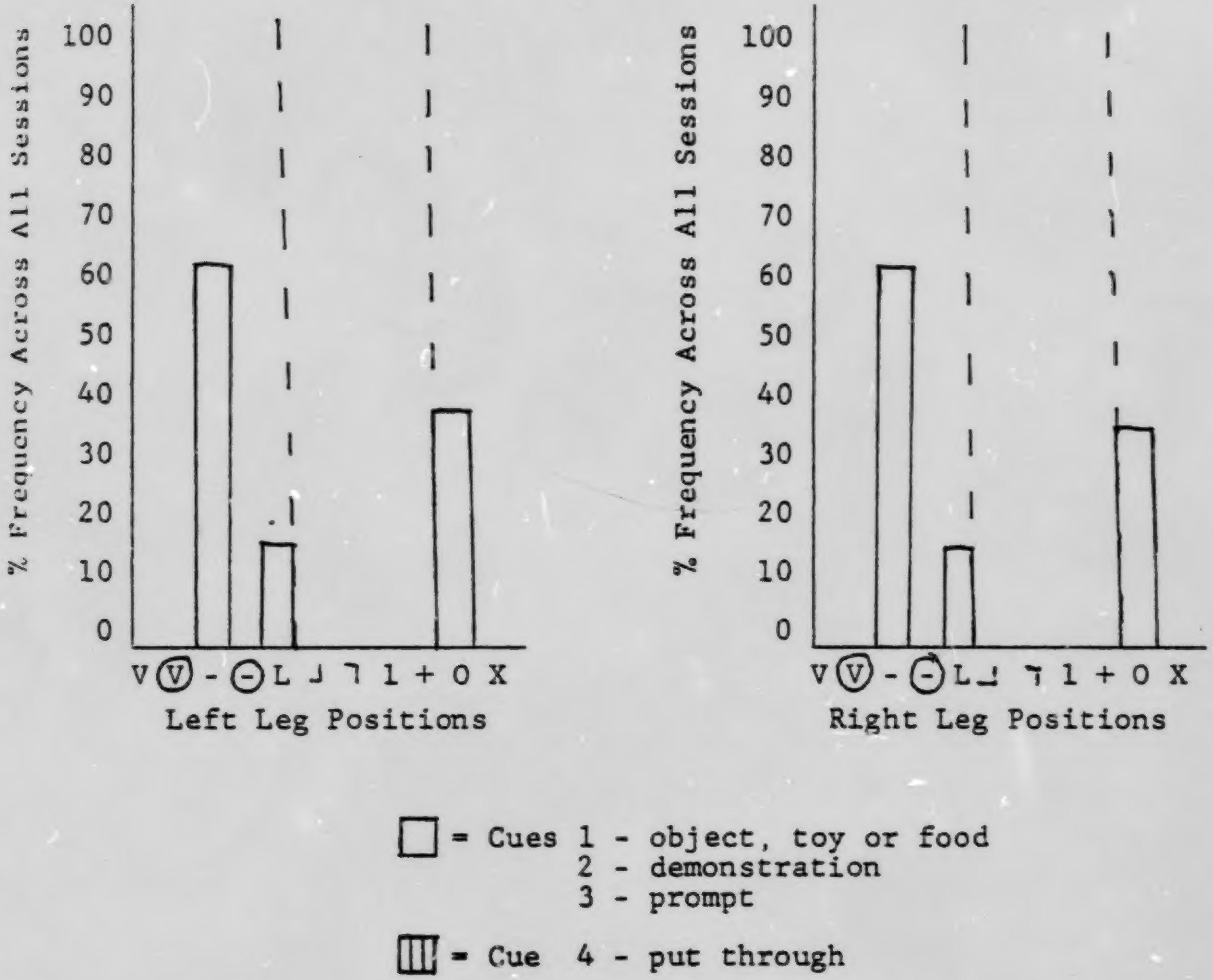


Figure 9. Michael's leg positions measured during maintenance in the position (Data Sheet #1) in the crawling study.

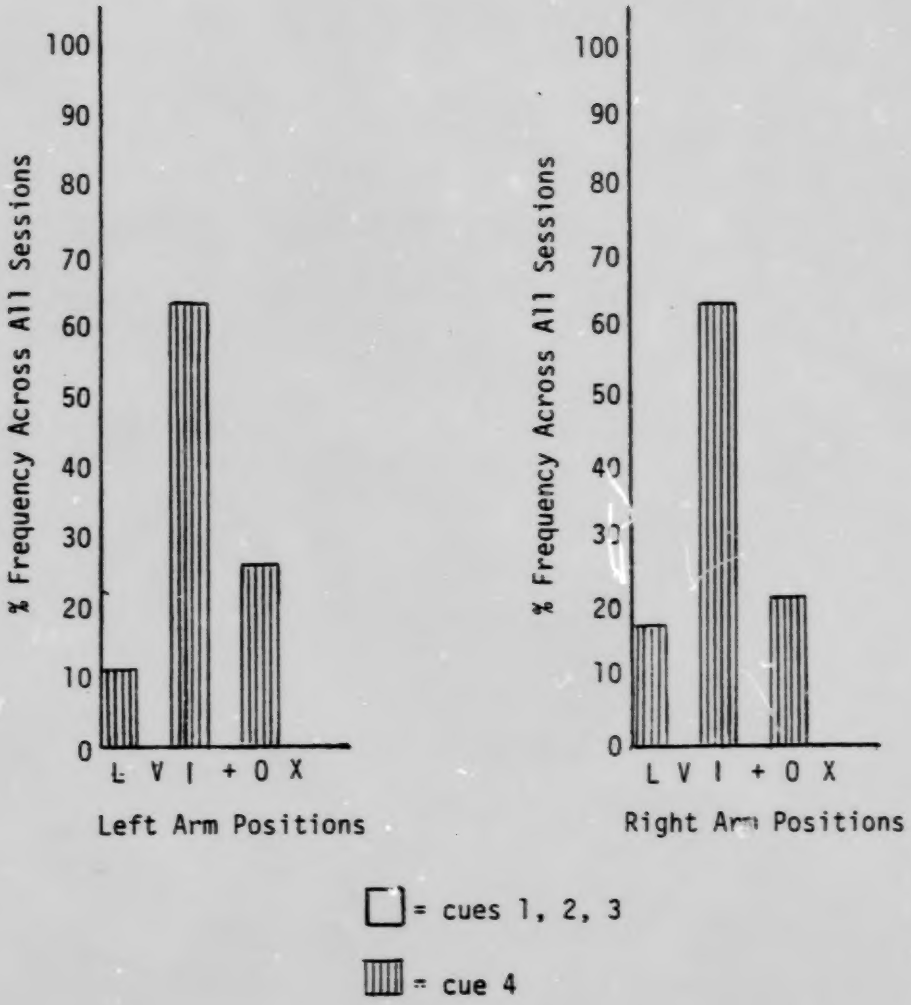


Figure 10. Pat's arm positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

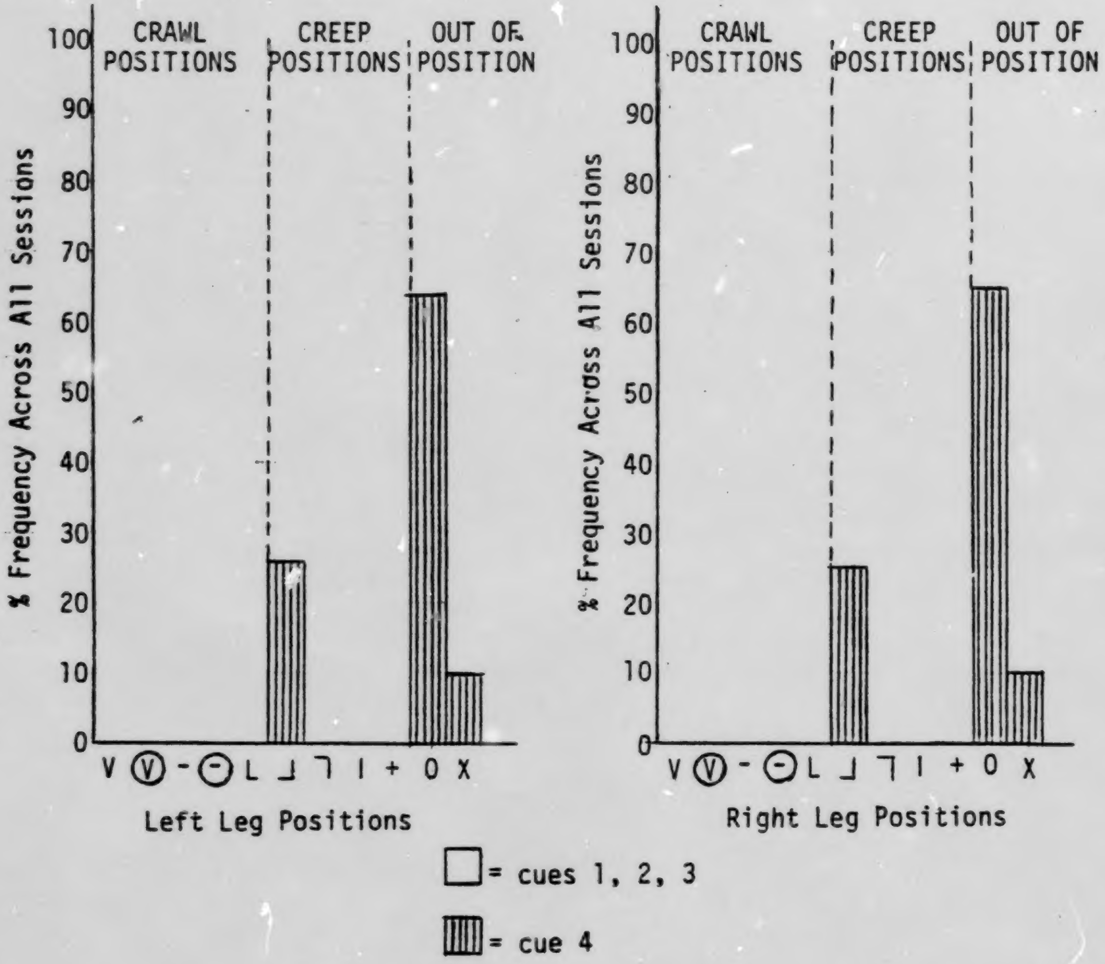
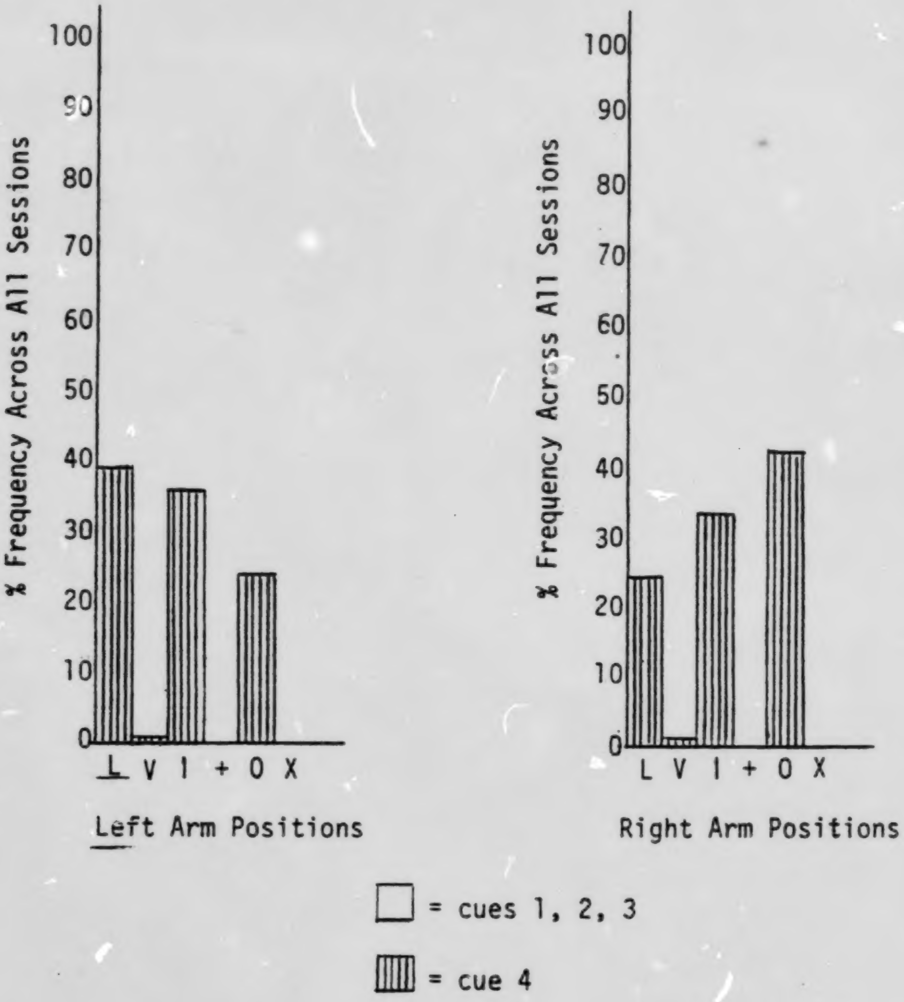
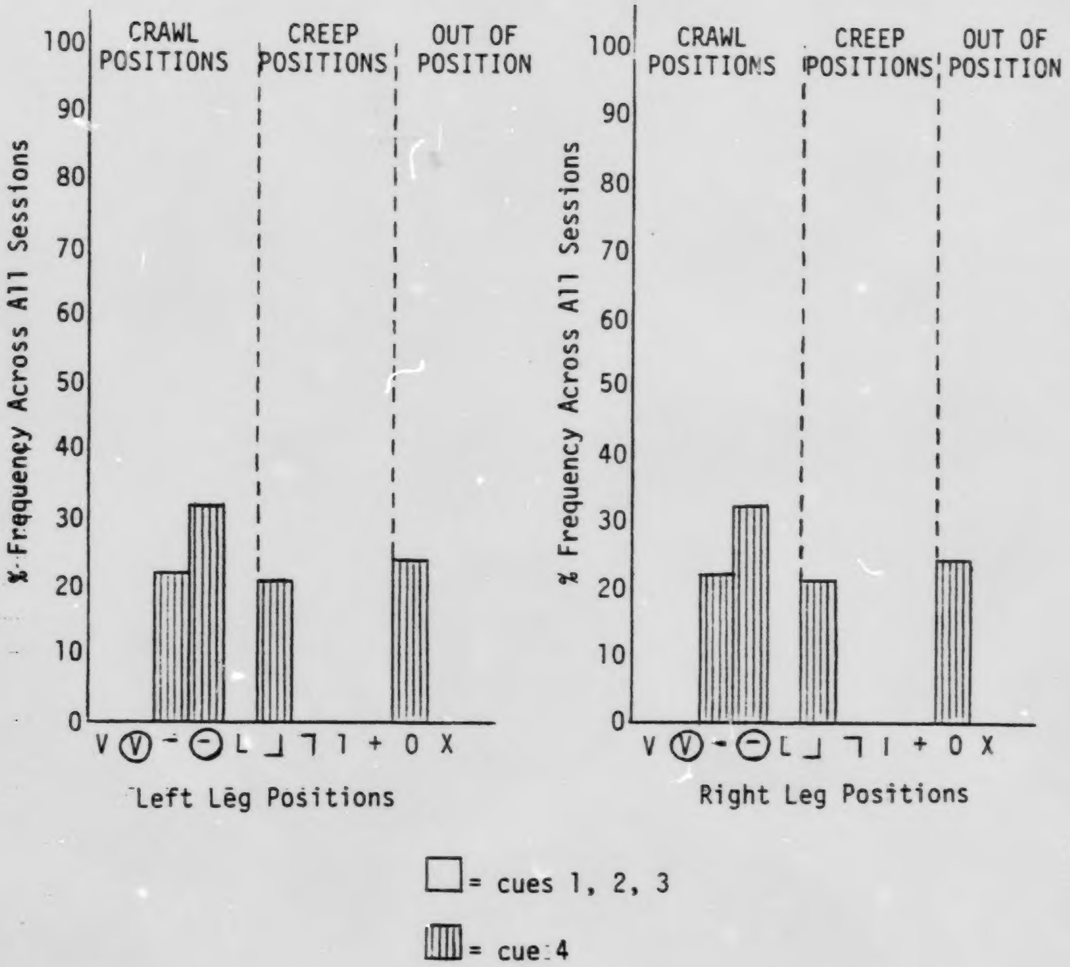


Figure 11. Pat's leg positions measured during maintenance in the position (Data Sheet #1) in the creeping study.



Note. For John, cue 4 was used to put him onto the creeping position. However, from the creeping position, he fell into the crawling position. The graph is deceiving in that John can maintain a crawling position with cues 1, 2, or 3 and this illustrates he needed cue 4. Since the trial began with cue 4 to measure creeping, crawling appears to need cue 4 as well, because it occurred after creeping. If John had been placed in prone, according to the assessment administration procedures, the graph would have shown him responding to cues 1, 2, or 3 with crawling behavior. Creeping would then have been assessed, and the graph would have been a better representation of his behavior, showing independent responses for crawling behavior, and dependent responses for creeping behavior.

Figure 12. John's arm positions measured during maintenance in the position (Data Sheet #1) in the creeping study.



Note. The regular assessment administration procedures were not applied in this study. If they had been, crawling would have been assessed as well as creeping. The graphs would then have reflected some independent behavior with the use of cues 1, 2, and 3, rather than showing that John needed cue 4 all the time. However, the purpose of this study was to measure creeping behavior. Therefore John had to be put into the creeping position with cue 4 in order for creeping to be measured.

Figure 13. John's leg positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

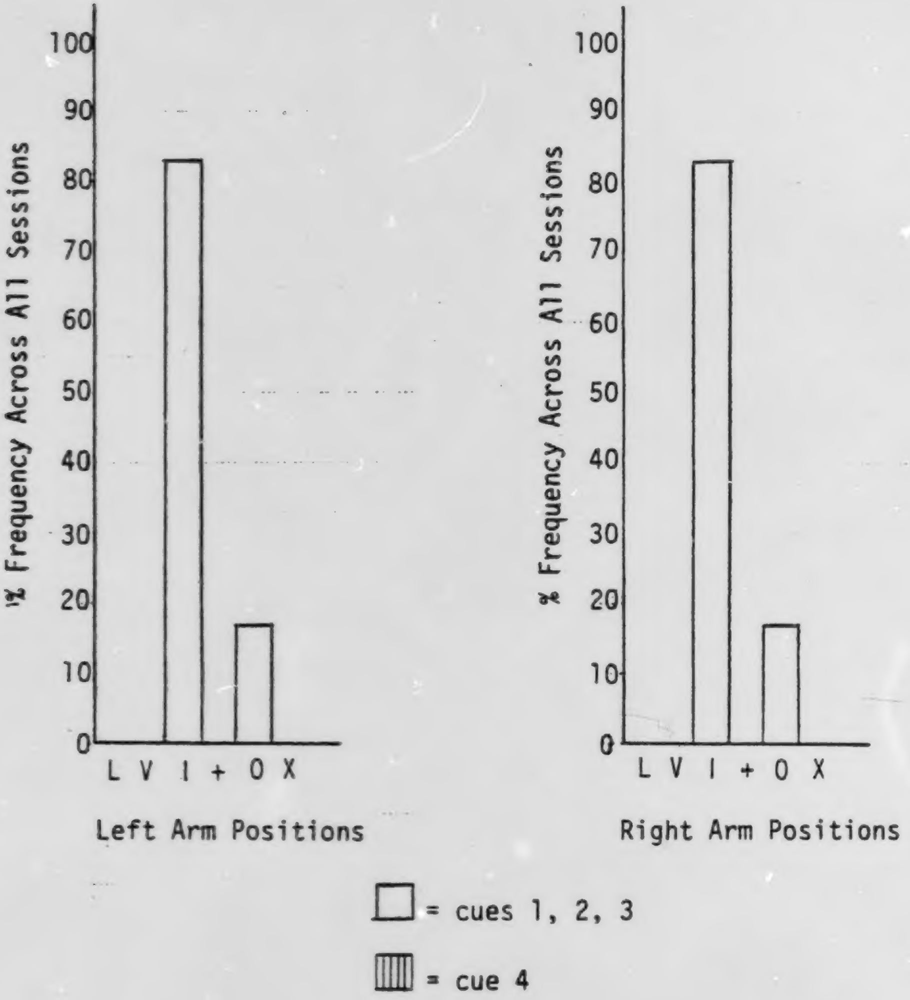


Figure 14. Gary's arm positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

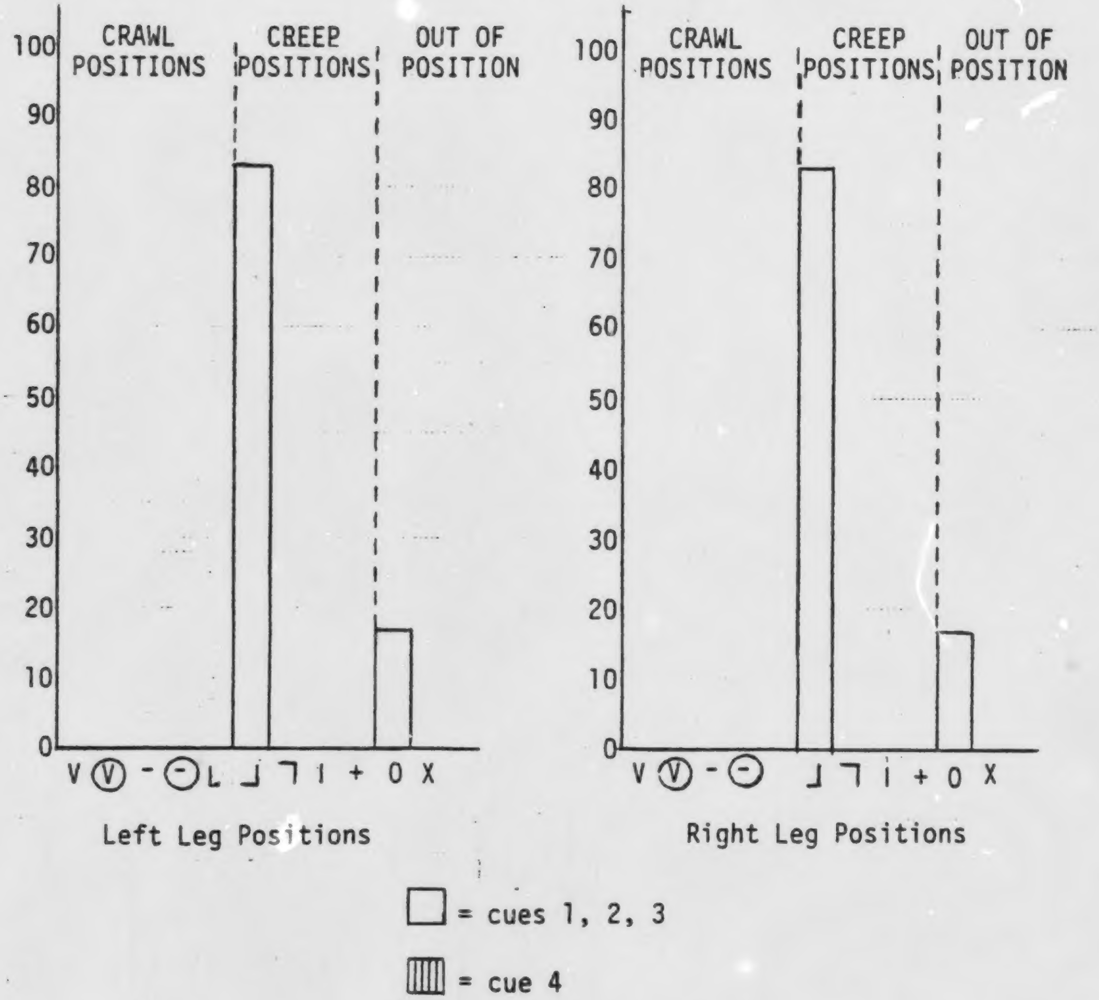


Figure 15. Gary's leg positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

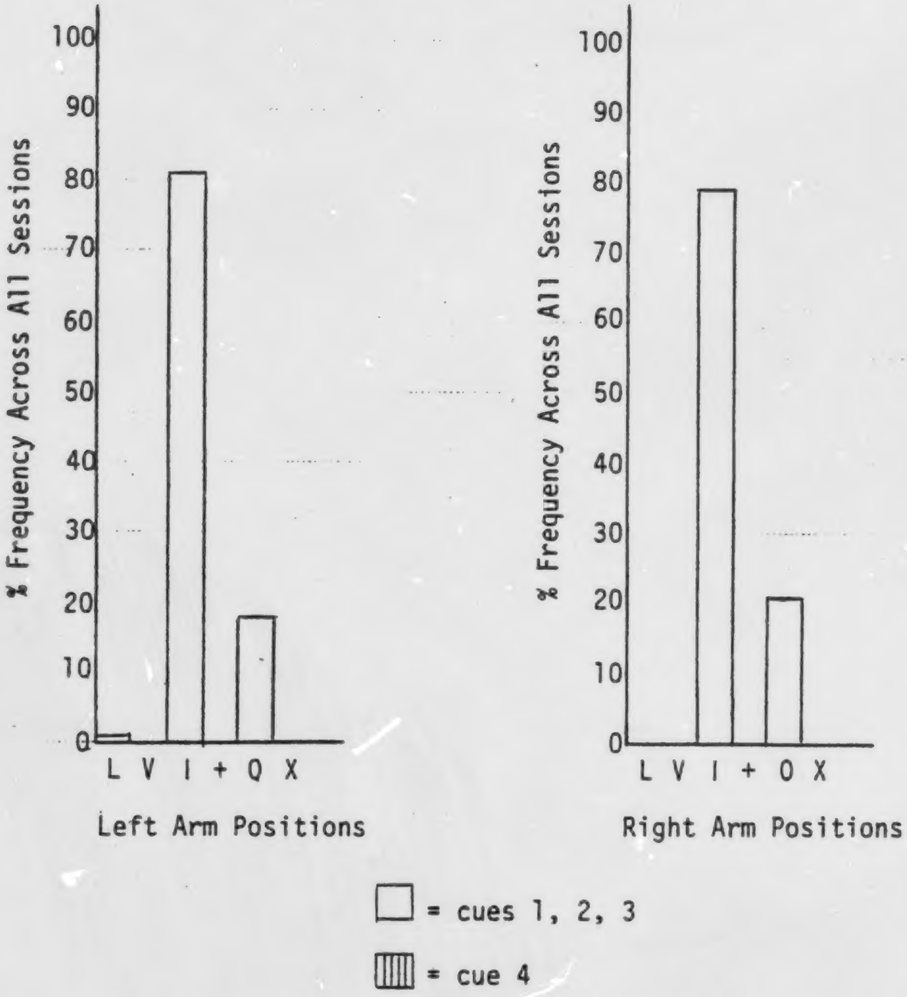


Figure 16. David's arm positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

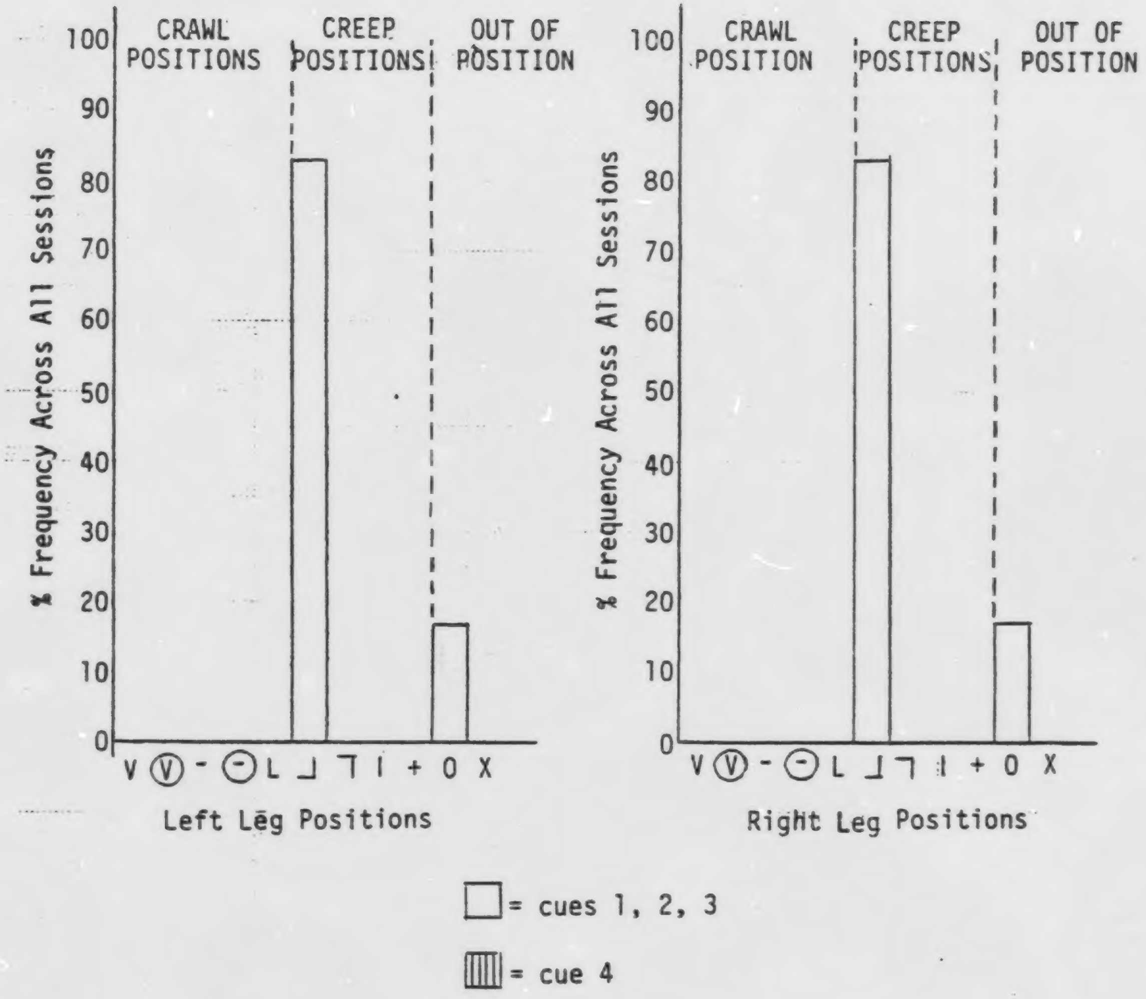


Figure 17. David's leg positions measured during maintenance in the position (Data Sheet #1) in the creeping study.

on forearms," and arm "out of position." "Leg flexed down," "leg extended actively," and leg "out of position" were the most frequent leg position responses demonstrated by all four children. The non-handicapped infant remained in the position the longest, 83% of the time as opposed to 26% of the time demonstrated by Pat (Subject 1).

Movement in the Position. Since each child obtained different durations for each trial, the movements in each trial were calculated by movements per minute. The formula used was:

$$\frac{\text{\# of movements}}{\text{total duration}} = \frac{X}{\text{60 seconds.}}$$

Appendix C includes data of the children in the crawling study. The data collected in the creeping study are found in Appendix D. Presented are movements per minute for each type of movement (pivots, rocks, steps) for each trial, as well as the total movements per minute for each trial. The mean movements per minute, the calculations graphed in Figure 18 and 19, were obtained by dividing the movements per minute by the total number of trials.

Leitner's data from the crawling study are presented in the graphs of Figure 18. Marc (Subject 1) demonstrated only crawling steps for movement in the position. The number of steps ranged from 6 to 17 with a mean of 15. Megan (Subject 2), Steven (Subject 3), and Michael (Subject 4) all had pivot and step responses. The mean number of pivots per session ranged from 1 to 4 and the mean number of steps taken per session ranged from 1 to 17. Both Steven (Subject 3) and Michael (Subject 4) had a session with a mean number of 17 steps; Michael took the most steps per trial, 35. Megan (Subject 2) was the only child to demonstrate

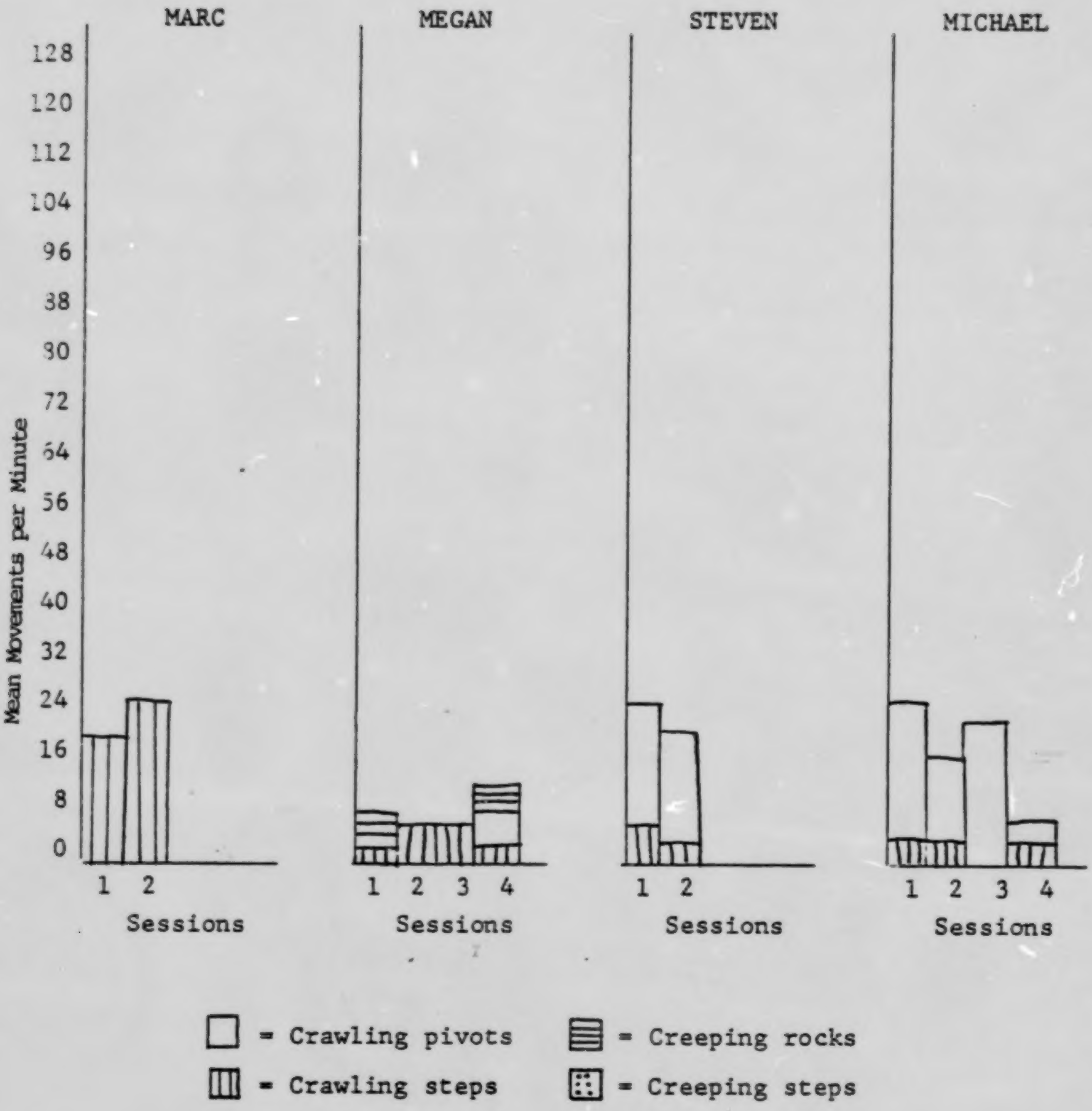


Figure 18. Marc, Megan, Steven, and Michael's mean movements per minute measured during movement in the position (Data Sheet #2) in the crawling study.

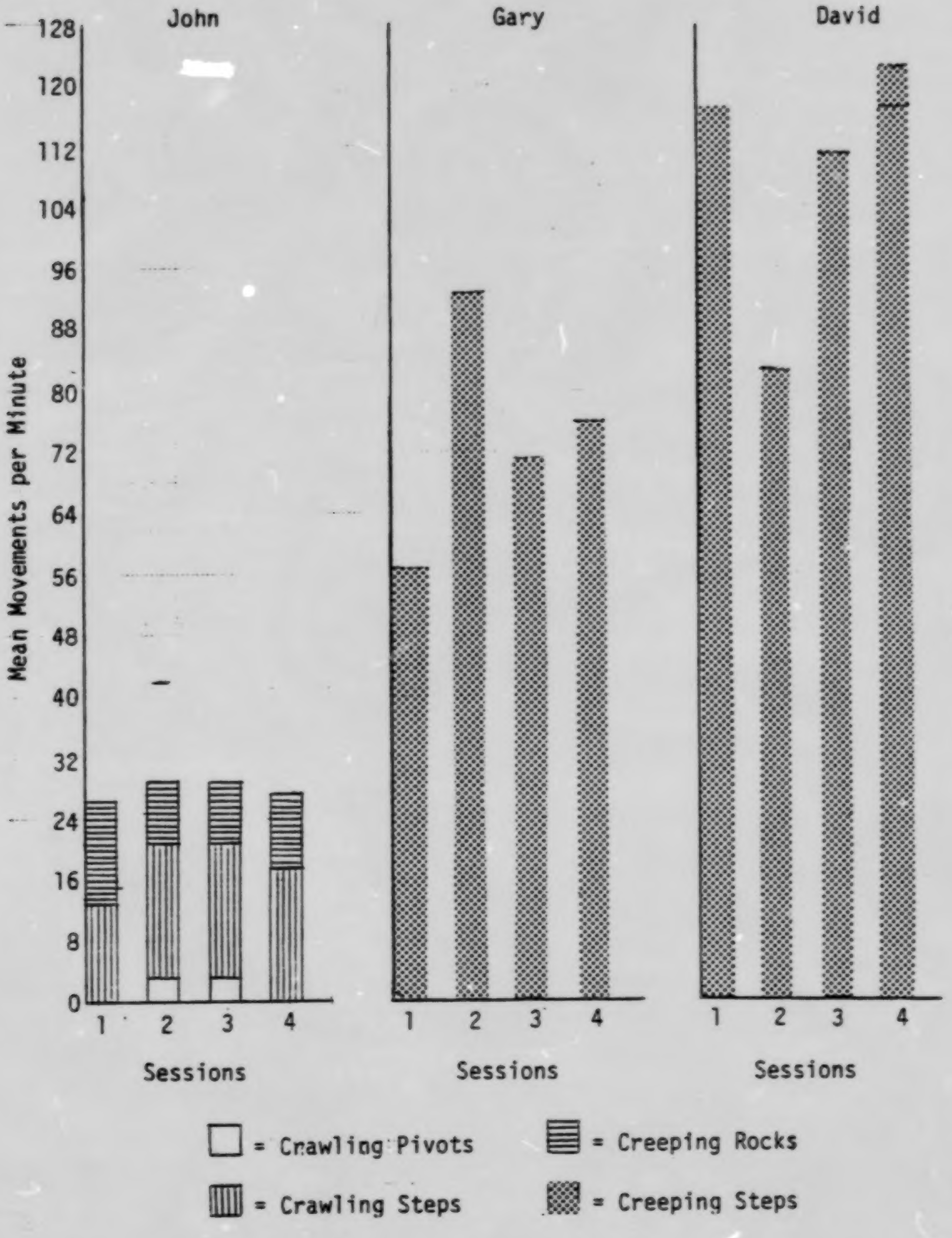


Figure 19. John, Gary, and David's mean movements per minute measured during movement in the position (Data Sheet #2) in the creeping study.

creeping movements. She rocked during two sessions with means of 4 and 9 rocks per session.

The study for creeping behavior had three children moving in the position and their data are graphically presented in Figure 19. John (Subject 2) demonstrated pivots, crawling steps, and creeping rocks, with crawling steps occurring more frequently than the other movements. The maximum mean crawling steps per minute for John was 17.7. Pivots only occurred in two sessions, three times for each minute session, and 13.3 rocks per minute was the maximum rate achieved in any of the four sessions.

Gary and David (Subjects 3 and 4) demonstrated creeping steps. The normal infant's (David) mean steps per minute exceeded Gary's (Subject 3) mean rate of movement. Gary's movements ranged from the mean of 57.3 steps per minute to 93.2 steps per minute, while David had 83.4 steps per minute to 123.9 steps per minute.

Locomotion in the Position. Various rates were examined on this data sheet, such as the rate of steps per minute, frequency of pattern per minute, and the distance traveled per minute. The occurrence or frequency of pattern was determined by counting the complete movement pattern of two or four different limbs as a unit. Four limbs were required for one pattern in creeping since both children utilized all four limbs. Appendix E includes the raw data scores for the children in the crawling study and Appendix F presents the performance data collected for the study measuring creeping behavior.

Figures 20 and 21 graphically present the locomotion data for the crawling study. The patterns observed were very similar across children. The three children who locomoted in the position, Marc (Subject 1),

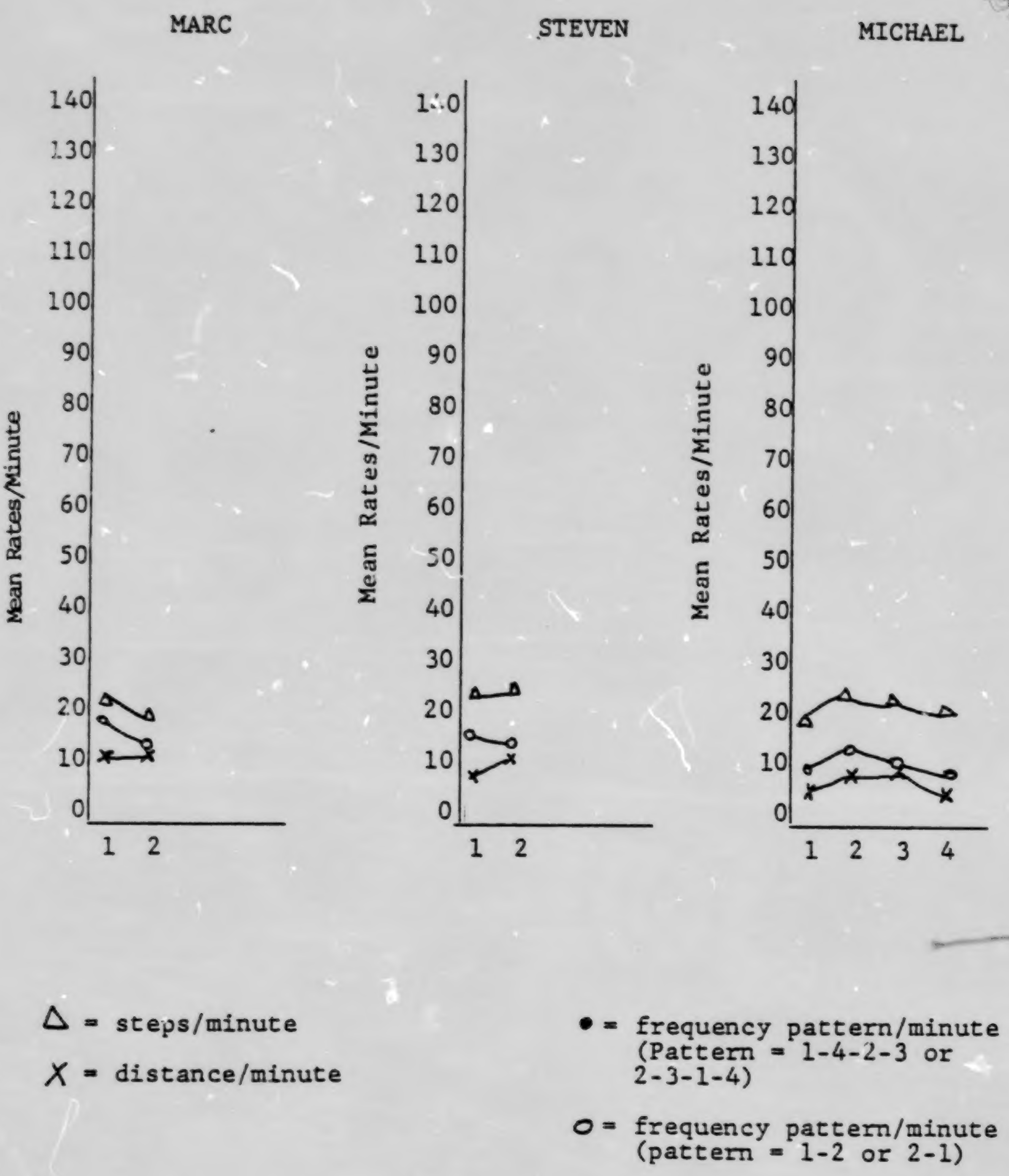


Figure 20. Marc, Steven, and Michael's mean rates per minute measured during locomotion in the position (Data Sheet #3) in the crawling study.

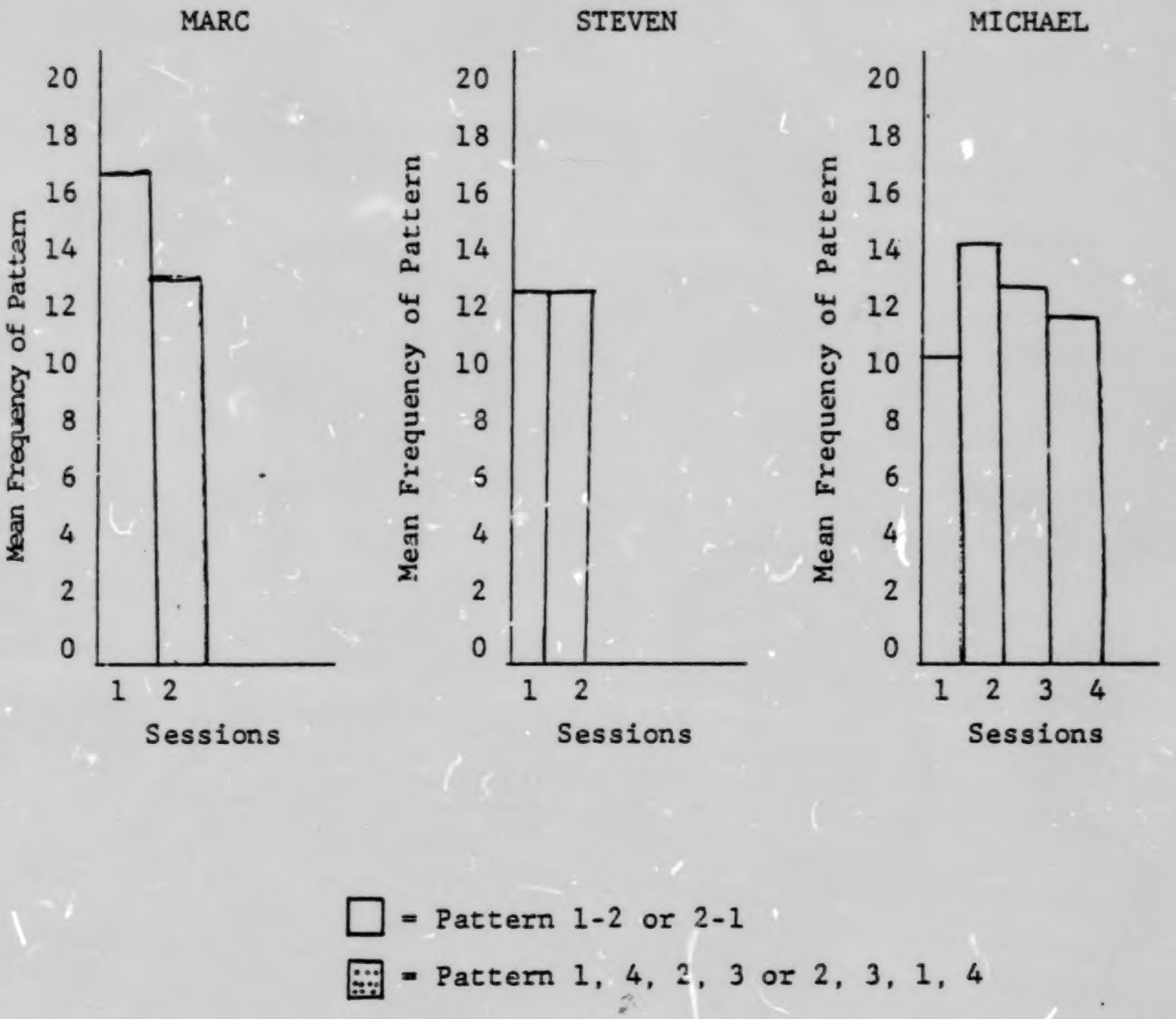


Figure 21. Marc, Steven, and Michael's mean frequency of pattern measured during locomotion in the position (Data Sheet #3) in the crawling study.

Steven (Subject 3) and Michael (Subject 4) used only 2 limbs (their arms) to crawl. The patterns observed were 1-2, 2-1, and 2-2; 1-2 and 2-1 both occurred with a mean frequency of 9, and 2-2 had a mean frequency of 5.5.

The distance per minute traveled and the rate of steps per minute remained fairly constant for all three children across sessions. Marc and Steven consistently crawled a distance of about 10 feet (criterion) and had means of 32 and 24 steps per minute; Mike's mean distance was 8 feet with a mean of 23 steps per minute.

The predominant pattern observed for the study measuring creeping behavior was 1-4-2-3 or 2-3-1-4, Gary (Subject 1) also demonstrated a 3-4 or a 4-3 pattern at the beginning of each trial. Both children's rate of steps per minute increased over time as did the distance per minute traveled by each child. The average rate of steps per minute for Gary varied from 66.8 to 90.9, and David's average rate of steps per minute increased from 24 to 132.9. Figures 22 and 23 contain the graphic illustrations of the locomotion data for Kremer's study (creeping).

Discussion

The reliability data indicated these procedures accomplished the goals of the crawling and creeping studies: to devise a measurement system that can be used to reliably measure finer increments of creeping behavior. The behaviors measured were maintenance, movement, and locomotion in the position. Each of these procedures will be discussed further in terms of how reliable the measurement of the behaviors were and what the limitations of the measurements provided.

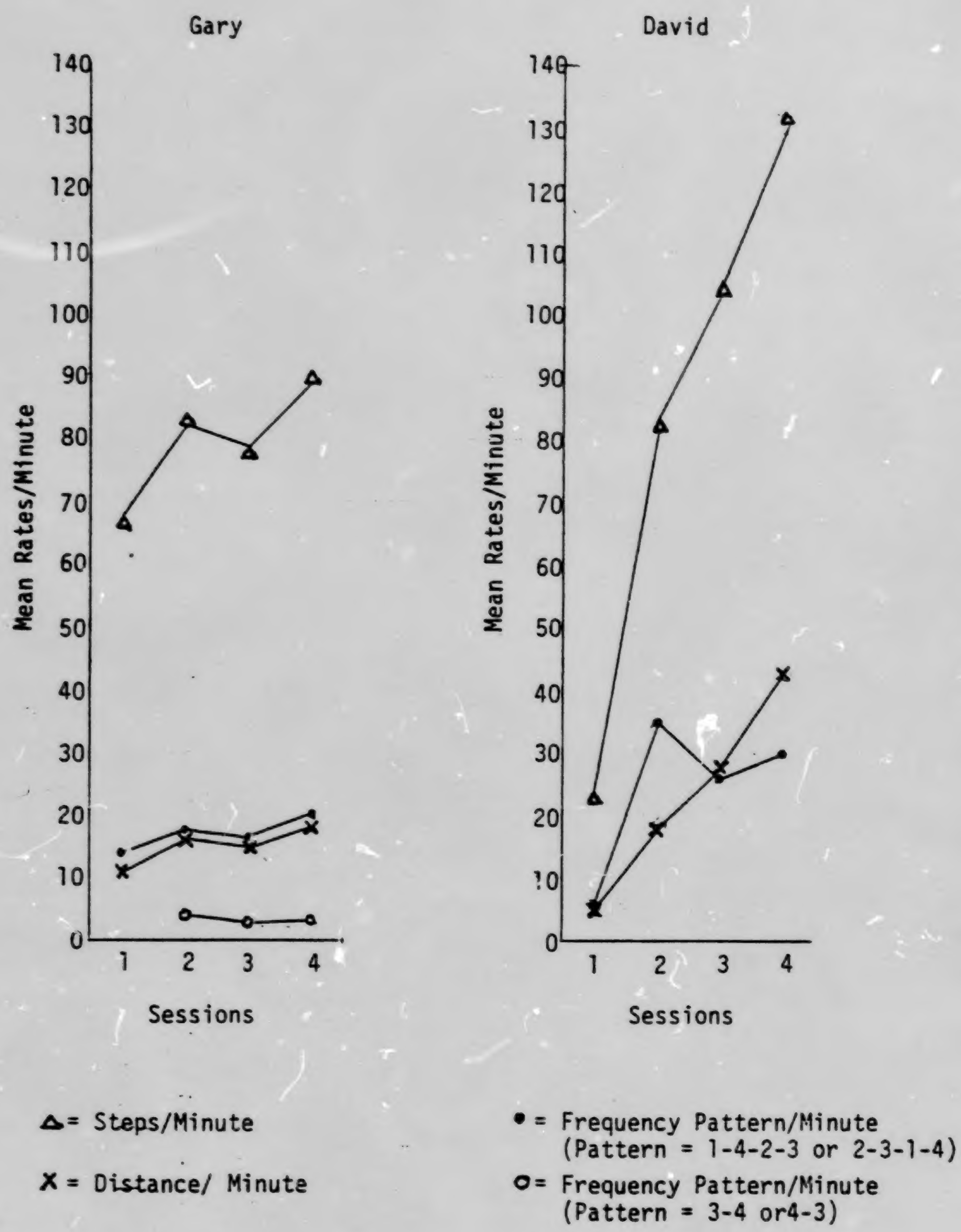


Figure 22. Gary and David's mean rates per minute measured during locomotion in the position (Data Sheet #3) in the creeping study.

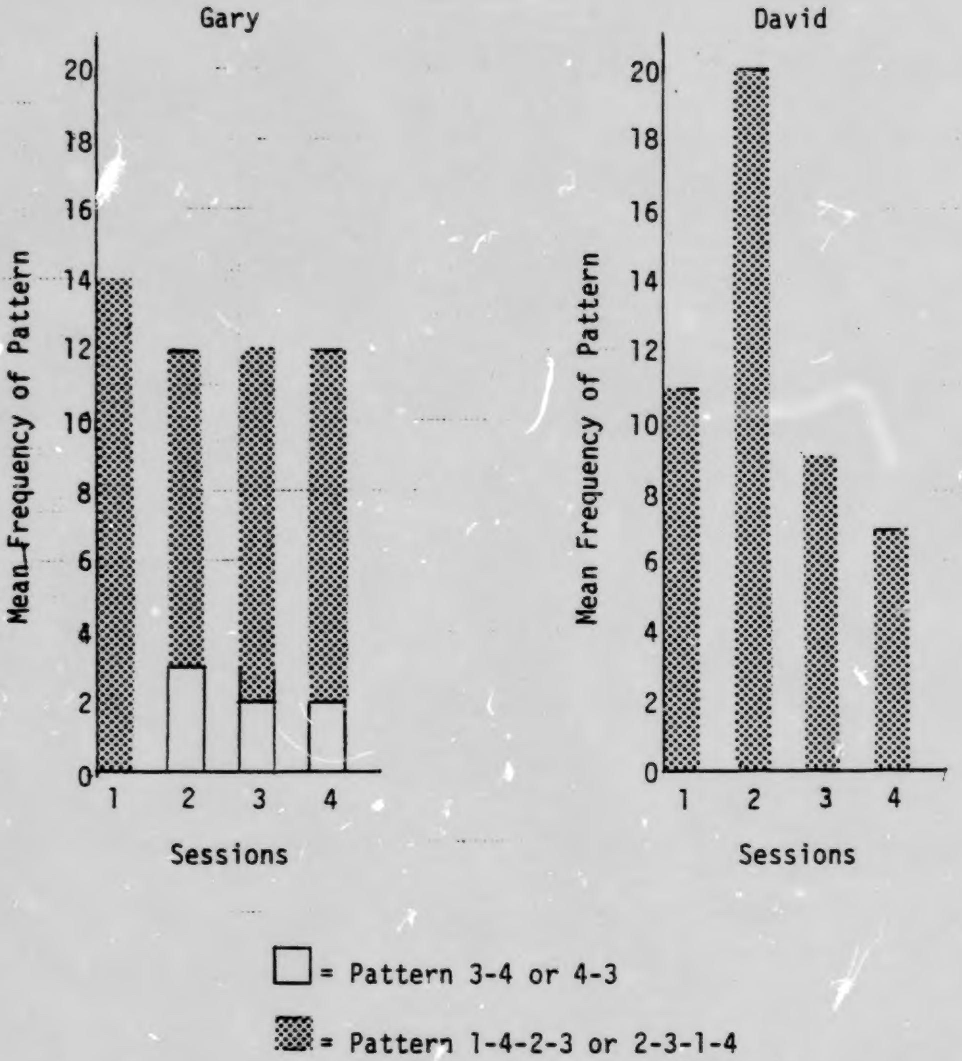


Figure 23. Gary and David's mean frequency of pattern measured during locomotion in the position (Data Sheet #3) in the creeping study.

Results from Performance Data

Maintenance in the position (data sheet #1). Originally, a data sheet was devised to measure behaviors for both maintenance and movement in the position. This however, did not break down the two behaviors into fine enough increments. Two data sheets were then devised that equally distributed the number of trials and number of behaviors on each data sheet. Reliability improved between observers with the adaptation of this procedure.

Continuous measurement of coding the arm and leg positions was attempted, but was found to result in unreliable recording. In lieu of this, the ten second momentary time sampling was selected, facilitating the scoring procedures.

Based on the analysis of reliability data, it appeared that the definitions, codes, and procedure of measuring maintenance in the position were objective and precise enough to obtain reliable data. However, upon closer examination, it became apparent that the use of momentary time sampling did not reflect an accurate measurement of the duration of the position the child maintained. The duration obtained from time sampling was either an overestimate or underestimate of the actual duration.

This assessment had an advantage over other instruments in that it individualized for each child. By coding arm and leg positions, a child did not have to conform to specific crawling or creeping positions as sometimes specified in other instruments. This procedure recorded the child's behavior and then measured progress by comparing the child's own data to itself. Progress was determined by comparing the number of "in position" behaviors to "out of position" and "abnormal tone" behaviors, and by comparing the amount of "crawling positions" to "creeping positions."

The last factors that affected the maintenance of the position were the surrounding environment and the stimulus items presented. If the student was tired or bored with the environment or stimulus items presented, the duration may not have been indicative of what position the student was capable of maintaining.

Movement in the position (data sheet #2). Only a few adaptations were made in this procedure after movement and maintenance procedures were separated into two data sheets. Since there was the separation of data sheets, there needed to be a discrimination made between crawling and creeping rocks and crawling and creeping steps. With data sheet #2, there were no provisions made to indicate whether the child was rocking or stepping in a crawling or creeping position. Therefore, separate columns were devised on the data sheet to distinguish between these behaviors.

The rate of each type of movement was also added to the second data sheet in order to further compare the progress or regression of a child as well as to determine whether measures for the third data sheet were to be administered.

The definitions and methods for counting creeping rocks and creeping steps were descriptive and clear enough to obtain reliability. However, in the case of a child with abnormal muscle tone, it was sometimes uncertain whether an arm had really moved or was dragging. The arm movements were not distinct from one another. The children with very definite movements were easier to count, as reflected in the reliability data.

With the rate of movement included in these procedures, two types of progress could be compared within a child. The first kind involved progress within the same behavior, e.g., an increase in creeping rocks. The second form of progress included the transition from one behavior to another, e.g., from creeping rocks to creeping steps. A decrease in rocking behavior could be an indication that the child was ready for creeping steps.

The duration scores recorded were very reliable. These procedures either required the student to move ten feet or maintain the crawling position for one minute, whichever came first.

Locomotion in the position (data sheet #3). The method used in these procedures did not take for granted that handicapped children would display normal developmental patterns of crawling and creeping. Therefore, the procedures used a method of numbering each of the four limbs and recording the numbers as each limb moved. This proved to be a fairly reliable procedure for coding this behavior. However, the reliability scores covered a wide range, from 82% to 100%. This variance in scores may indicate how unreliable these procedures could have been. Usually, the initial data were unreliable with each new observer until the observers became more familiar with the child's pattern of movement and had practice in writing as fast as the child moved.

Another limitation with this procedure was the coding system used. This procedure did not indicate whether the limbs moved simultaneously or consecutively. Two attempts were used to try and alleviate this problem. The first attempt was to underline the number of the limbs that moved simultaneously, e.g., 1 2 3 4. The second attempt was to record closer together the number of each limb that moved simultaneously, e.g., 12 34. Both of these techniques were abandoned since they were too difficult to record and decreased reliability scores.

Other techniques that were considered in order to improve the data taking measures for this procedure were the use of video tapes and a tape recorder. The video machine was ruled out since many teachers do not have access to this equipment. Orally recording the numbers on a tape recorder was eliminated because of the possible audio confusion resulting from two people recording at the same time. It seems however, that with the recommendations for change in this procedure discussed in the next section, this procedure will be a very feasible one in determining how a child moves. No other assessment breaks down a child's movements into such detail.

Distance the child traveled was also measured on this data sheet and is another good indicator of progress that most assessments do not consider.

Problems with Testing Procedures

There were various limitations to this assessment, although many of them were not unique to just this particular assessment. The first limitation was that the behavior the child demonstrated depended highly upon the motivation of the child. Therefore, this assessment may not have demonstrated the maximum performance of each child. This inability to demonstrate maximum performance could have created a problem of the child not moving the required number of steps on data sheet #2 to meet the criterion required to move on to data sheet #3.

A child who demonstrated both crawling and creeping behaviors may have demonstrated only crawling for three trials instead of creeping, and led the observer to conclude that he or she could only crawl. This behavior resulted in the initial positioning of the child for crawling since independent crawling behavior was only observed; creeping was then not assessed. Sensitivity to each child's behavior and subjective decisions regarding the child demonstrating his or her maximum potential was necessary for this assessment. Additionally, the observer had to be certain that the lures being used were very reinforcing to the child and that satiation from the stimuli did not occur. New reinforcers had to be introduced every few trials for some children.

Another major problem with this assessment was the time factor involved. When the assessment was conducted in one setting, many of the children became tired or bored by the third data sheet. Therefore, the children did not perform as well on the third data sheet as they did on the first and second data sheets. This made it very difficult for the examiner to get an accurate sample of a pattern of crawling or creeping.

The type of cues used and the presentation of those cues was a major area of difficulty in prototyping these assessment procedures. In the initial stages of development only cue 1 (toys, object, food, or liquid) and cue 4 (put through) were used. The put through was too much for some students who needed only a minimal amount of assistance to demonstrate the required position. To alleviate this problem, cue 2 (demonstration) and cue 3 (prompt) were added to the list of cues. Another discrepancy with this part of the assessment was the definition of the beginning of each trial. This ultimately was defined as the trial beginning when the observer no longer maintained contact with the student, and the student was maintaining the desired position using one of the four cues.

Initially, each of the trials for maintenance, movement, and locomotion in the position were two minutes in length. Each of these three behaviors consisted of three trials. The length of the trial was later changed from two minutes to one minute. This reduced the total length of the assessment from approximately 90 minutes to 50 minutes. This helped alleviate some of the problems of boredom and fatigue of the observers and student. The number of trials remained the same, since the authors felt that less than three trials would not be a sufficient sampling of the student's behavior.

Differences of opinion occurred between observers as to what was considered out of position and what was abnormal tone. These differences definitely affected the reliability data. The problem arose most often between very sophisticated experienced data collectors and those with less knowledge of abnormal reflexes.

Implications and Recommendations for Research

Many of the assessment's limitations have been discussed. Some of the problems were resolved with changes in the procedures, while others continue to be problems. The following are some recommendations which will further improve the quality of the assessment.

In data sheet #1, a reduction in the number of arm and leg positions might eliminate some of the confusion between the positions and improve the accuracy of the recording procedure. Fewer positions may result in a shorter training period for the observer to become proficient in the use of the assessment.

With regard to positions, there is a need to concurrently code abnormal muscle tone with the positions of the arms and legs. Many times reliability was reduced because of the confusion between observers on the two codes. For example, the arms could be internally or externally rotated, but still be extended down and supporting the child. Thus, the child would be marked as out of position, even though he or she could still maintain the position. Confusion could also be reduced by combining out of position behaviors with abnormal tone behaviors under one code. Similar conditions also apply to the legs.

For data sheet #2, "Movement in the Position," the distance should have been recorded so that the stride of the steps could have been calculated. However, in order to calculated the stride, the method of counting each limb separately as it moved, either simultaneously or consecutively, needed to be changed. To measure stride, the limbs which moved separately should have been counted as one step, as well as the limbs that move together. Therefore, an arm and leg which moved together should be counted as one step instead of two.

Data sheet #3 recording procedures could have been greatly simplified if data were only taken for short intervals totaling a two minute duration period. This would have reduced the observers' frustration which occurred when their recording of numbers fell behind. Comparison of reliability data would have been more accurate if shorter intervals were used, having a greater probability of comparing the same steps within an interval instead of assuming that the steps being compared in the two minute sessions were the same.

The data from these assessment procedures, if used on a longitudinal basis, should enable the educator of the severely, profoundly handicapped or of the normal child to compare progress in crawling or creeping within a student. From the information collected on the various behaviors of crawling and creeping, the teacher or therapist should be better able to formulate more precise instructional objectives and then evaluate the effectiveness of the training procedures.

APPENDICES

APPENDIX A

Performance Data for Maintenance in the Position in the Crawling Study

Student	Arm Position	Left Arm	Right Arm
1	L	22%	44%
	V	19%	8%
	1	19%	8%
	+	-	3%
	O	39%	36%
	X	-	-
2	L	37%	29%
	V	-	-
	1	41%	40%
	+	-	-
	O	22%	31%
	X	-	-
3	L	80%	52%
	V	5%	28%
	1	3%	-
	+	-	-
	O	12%	20%
	X	-	-
4	L	15%	39%
	V	-	6%
	1	26%	15%
	+	6%	-
	O	49%	40%
	X	-	-

Student	Leg Position	Left Leg	Right Leg
1	V	-	8%
Crawl Positions	V	-	-
	-	25%	23%
	-	-	-
	L	36%	31%
Creep Positions	J	3%	3%
	7	-	-
	1	-	-
	+	-	-
Out Positions	O	36%	36%
	X	-	-
2	V	4%	2%
Crawl Positions	V	-	-5
	-	64%	58%
	-	-	-
	L	7%	12%
Creep' Positions	J	6%	4%
	7	-	-
	1	2%	2%
	+	-	-
Out Positions	O	18%	18%
	X	-	-
3	V	-	-
Crawl Positions	V	-	-
	-	100%	100%
	-	-	-
	L	-	-
Creep Positions	J	-	-
	7	-	-
	1	-	-
	+	-	-
Out Positions	O	-	-
	X	-	-
4	V	-	-
Crawl Positions	V	-	-
	-	60%	60%
	-	-	-
	L	-	-
Creep Positions	J	3%	3%
	7	-	-
	1	-	-
Out Positions	O	37%	37%
	X	-	-

M(C)56

Student	Modal Response				Modal Position			
	Left Arm	Right Arm	Left Leg	Right Leg	Left Arm	Right Arm	Left Leg	Right Leg
1	0	L	0	0	L	L	L	L
2	1	1	-	-	1	1	-	-
3	L	L	-	-	L	L	-	-
4.	0	0	-	-	1	L	-	-

Student	
1	231/360 sec. or 64%
2	597/720 sec. or 82.9%
3	330/360 sec. or 91.7%
4	450/720 sec. or 63%

APPENDIX B

Performance Data for Maintenance in the Position in the Creeping Study

Student	Arm Position	Left Arm	Right Arm
1	L	11%	17%
	V	-	-
	I	63%	63%
	+	-	-
	0	26%	21%
	X	-	-
2	L	39%	24%
	V	1%	1%
	I	36%	33%
	+	-	-
	0	24%	42%
	X	-	-
3	L	-	-
	V	-	-
	I	83%	83%
	+	-	-
	0	17%	17%
	X	-	-
4	L	1%	-
	V	-	-
	I	81%	79%
	+	-	-
	0	18%	21%
	X	-	-

Student	Arm Position	Left Leg	Right Leg
1	V	-	-
	Ⓥ	-	-
CRAWL POSITIONS	-	-	-
	⊖	-	-
	L	-	-
	┘	26%	25%
CREEP POSITIONS	┐	-	-
	I	-	-
	+	-	-
OUT POSITIONS	0	64%	65%
	X	10%	10%
2	V	-	-
	Ⓥ	-	-
CRAWL POSITIONS	-	22%	22%
	⊖	32%	32%
	L	-	-
	┘	21%	21%
CREEP POSITIONS	┐	-	-
	I	-	-
	+	-	-
OUT POSITIONS	0	24%	24%
	X	-	-
3	V	-	-
	Ⓥ	-	-
CRAWL POSITIONS	-	-	-
	⊖	-	-
	L	-	-
	┘	83%	83%
CREEP POSITIONS	┐	-	-
	I	-	-
	+	-	-
OUT POSITIONS	0	17%	17%
	X	-	-
4	V	-	-
	Ⓥ	-	-
CRAWL POSITIONS	-	-	-
	⊖	-	-
	L	-	-
	┘	83%	83%
CREEP POSITIONS	┐	-	-
	I	-	-
	+	-	-
OUT POSITIONS	0	17%	17%
	X	-	-

M(C)59

Student	Modal Response				Modal Position				Total Duration
	Left Arm	Right Arm	Left Leg	Right Leg	Left Arm	Right Arm	Left Leg	Right Leg	
1	│	│	0	0	│	│	┘	┘	190/720 sec. or 26%
2	L	0	⊖	⊖	L	│	⊖	⊖	540/720 sec. or 75%
3	│	│	┘	┘	│	│	┘	┘	560/720 sec. or 78%
4	│	│	┘	┘	│	│	┘	┘	600/720 sec. or 83%

APPENDIX C

Performance Data for Movement in the Position in the Crawling Study

Student	Session	Crawling			Creeping		Total Rate
		Pivots	Rocks	Steps	Rocks	Steps	Movement Min
1	1	-	-	8	-	-	8
		-	-	13	-	-	13
		-	-	6	-	-	6
	Mean	-	-	9	-	-	9
	2	-	-	13	-	-	13
		-	-	27	-	-	27
		-	-	19	-	-	19
	Mean	-	-	20	-	-	20
2	1	1	-	-	8	-	9
		1	-	-	3	-	4
		1	-	-	-	-	1
	Mean	1	-	-	4	-	5
	2	3	-	-	-	-	3
		2	-	-	-	-	2
		4	-	-	-	-	4
	Mean	3	-	-	-	-	3
	3	3	-	-	-	-	3
		1	-	-	-	-	1
		4	-	-	-	-	4
	Mean	3	-	-	-	-	3
	4	3	-	-	12	-	15
		-	-	-	1	-	1
		1	-	4	13	-	18
	Mean	1	-	1	9	-	11
3	1	-	-	35	-	-	35
		12	-	-	-	-	12
		-	-	15	-	-	15
	Mean	4	-	17	-	-	21
	2	6	-	9	-	-	15
		-	-	29	-	-	20
		-	-	12	-	-	12
	Mean	2	-	14	-	-	16

Student	Session	Crawling			Creeping		Total Rate
		Pivots	Rocks	Steps	Rocks	Steps	Movement Min
4	1	-	-	2	-	-	2
		-	-	2	-	-	2
		-	-	17	-	-	17
	Mean	-	-	7	-	-	7
	2	-	-	3	-	-	3
		-	-	18	-	-	18
		5	-	11	-	-	16
	Mean	1	-	11	-	-	12
	3	-	-	20	-	-	20
		-	-	13	-	-	13
		-	-	19	-	-	19
	Mean	-	-	17	-	-	17
	4	4	-	2	-	-	6
		-	-	-	-	-	-
		-	-	-	-	-	-
	Mean	1	-	1	-	-	2

APPENDIX D

Performance Data for Movement in the Position in the Creeping Study

Student	Session	Crawling			Creeping		Total Rate
		Pivots	Rocks	Steps	Rocks	Steps	Movem/Min
2	1	-	-	17	7	-	24
		-	-	5	24	-	29
		-	-	18	9	-	27
	Mean	-	-	13.3	13.3	-	26.7
	2	3	-	4	5	-	12
		-	-	21	15	-	36
		-	-	28	3	-	31
	Mean	3	-	17.7	7.7	-	26.3
	3	3	-	4	5	-	12
		-	-	21	15	-	36
		-	-	28	3	-	31
	Mean	3	-	17.7	7.7	-	26.3
	4	-	-	24	5	-	29
		-	-	13	15	-	28
		-	-	16	11	-	27
	Mean	-	-	17.7	10.3	-	28
3	1	-	-	-	-	56.5	56.5
		-	-	-	-	58.8	58.8
		-	-	-	-	56.6	56.6
	Mean	-	-	-	-	57.3	57.3
	2	-	-	-	-	90.8	90.8
		-	-	-	-	90	90
		-	-	-	-	98.8	98.8
	Mean	-	-	-	-	93.2	93.2
	3	-	-	-	-	79	79
		-	-	-	-	48	48
		-	-	-	-	87.3	87.3
	Mean	-	-	-	-	71.4	71.4
	4	-	-	-	-	81	81
		-	-	-	-	62	62
		-	-	-	-	85.5	85.5
	Mean	-	-	-	-	76.1	76.1

Student	Session	Crawling			Creeping		Total Rate
		Pivots	Rocks	Steps	Rocks	Steps	Movem/Min
4	1	-	-	-	-	105	105
		-	-	-	-	137.1	137.1
		-	-	-	-	109.2	109.2
	Mean	-	-	-	-	117.1	117.1
	2	-	-	-	-	65	65
		-	-	-	-	65.2	65.2
		-	-	-	-	120	120
	Mean	-	-	-	-	83.4	83.4
	3	-	-	-	-	53.8	53.8
		-	-	-	-	135.7	135.7
		-	-	-	-	145.7	145.7
	Mean	-	-	-	-	111.7	111.7
	4	-	-	-	-	114.3	114.3
		-	-	-	-	166.1	166.3
		-	-	-	-	91.2	91.2
	Mean	-	-	-	-	123.9	123.9

APPENDIX E

Performance Data for Locomotion in the Position in the Crawling Study

Session	Total Steps	Total Duration	Rate Steps/Min	Distance	Rate Dist/Min	Patterns	Frequency of Pattern	Rate Pattern Freq/Min
1	9	35	15.4	10	17	2-2	4	6.9
	22	40	33	10	15	2-2	11	16.5
	18	25	43.2	10	24	2-2	12	28.8
Mean	16.3	33.3	30.5	10	18.7	2-2	9	17.4
2	10	30	20	10	20	2-2	5	10
	21	35	36	10	17.1	2-2	10	17.1
	19	30	38	10	20	2-2	9	18
Mean	16.7	31.7	31.3	10	19	2-2	8	15

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Performance Data for Marc (1)

Session	Total Steps	Total Duration	Rate Steps/Min	Distance	Rate Dist/Min	Patterns	Frequency of Pattern	Rate Pattern Freq/Min
1	29	45	38.7	10	13.3	2-1	14	18.7
	29	90	19.3	10	6.7	1-2	14	9.3
	13	120	6.5	8	4	1-2,2-1	6	3
Mean	23.7	85	21.5	9	8	1-2,2-1	11.3	10.3
2	22	55	24	10	10.9	1-2	11	12
	25	37	40.5	10	16.2	1-2	12	19.5
	18	70	15.4	10	8.6	2-1	9	7.7
Mean	21.7	54	26.6	10	11.9	1-2,2-1	10.7	13

M(C)68

Performance Data for Steven (3)

M(C)69

Session	Total Steps	Total Duration	Rate Steps/Min	Distance	Rate Dist/Min	Patterns	Frequency of Pattern	Rate Pattern Freq/Min
1	7	50	8.4	0	0	1-2	3	3.6
	38	80	28.5	15	11.2	2-1	16	12
						2-2	5	3.7
	9	30	18	3	6	2-1	2	4
						2-2	2	4
Mean	18	53.3	18.3	6	5.7	2-1,1-2	7	6.5
						2-2	3.5	3.8
						2-2	5	6
2	20	30	40	10	20	1-1	2	6
						2-1,1-2	7	14
						2-2	3	6
	23	70	19.7	10	8.6	2-2	2	1.7
						2-1	9	7.7
	18	80	13.5	9	6.8	2-2	3	2.5
						1-2	6	4.5
Mean	20.3	60	19.2	9.7	9.1	1-1	2	4
						2-2	2	4
						1-2,2-1	7.3	8.7
3	21	60	21	10	10	1-2,2-1	10	10
	24	60	24	10	10	1-2	11	11
	26	40	39	10	15	1-2	13	19.5
Mean	23.7	53.3	28	10	12	1-2,2-1	11	13.5
4	9	10	54	3	18	1-2	4	24
	36	100	21.6	10	6	1-2	12	7.2
						2-2	5	3
	13	120	6.5	7	4	1-2	5	2.5
	19.3	76.7	27.4	7	9	1-2	7	11.2
						2-2	5	3.0

Performance Data for Mike (4)

APPENDIX F

Performance Data for Locomotion in the Position in the Creeping Study

Session	Total Steps	Total Duration	Rate Steps/Min.	Distance	Rate Dist./Min.	Patterns Occurring 2X or More	Frequency of Pattern	Rate Pattern/Freq./Min.
1	62	58 sec.	64.1	10 ft.	10.3	1-4-2-3 or 2-3-1-4	15X	15.5
	51	51 sec.	60	10 ft.	11.8	1-4-2-3 or 2-3-1-4	12X	14.1
	63	51 sec.	74.1	10 ft.	11.8	1-4-2-3 or 2-3-1-4	15X	17.6
Mean	59	53 sec.	66.8	10 ft.	11.3	1-4-2-3 or 2-3-1-4	14X	14
2	54	48 sec.	67.5	10 ft.	12.5	1-4-2-3 or 2-3-1-4	11X	13.8
						3-4 or 4-3	4X	5
	47	34 sec.	82.9	10 ft.	17.6	1-4-2-3 or 2-3-1-4	9X	15.9
						3-4 or 4-3	2X	3.5
	54	30 sec	108	10 ft.	20	1-4-2-3 or 2-3-1-4	12X	24
						3-4 or 4-3	3X	6
Mean	52	37 sec.	84.3	10 ft.	16.2	1-4-2-3 or 2-3-1-4	11X	17.8
						3-4 or 4-3	3X	4.9
3	49	34 sec.	86.5	10 ft.	17.6	1-4-2-3 or 2-3-1-4	11X	19.4
	52	45 sec.	69.3	10 ft.	13.3	1-4-2-3 or 2-3-1-4	12X	16
						3-4 or 4-3	2X	2.7
	53	37 sec.	85.9	10 ft.	16.2	1-4-2-3 or 2-3-1-4	11X	17.8
						3-4 or 4-3	2X	3.2
Mean	51	39 sec.	78.5	10 ft.	15.4	1-4-2-3 or 2-3-1-4	11X	16.9
						3-4 or 4-3	2X	3.1
4	53	35 sec.	90.9	10 ft.	17.1	1-4-2-3 or 2-3-1-4	11X	18.9
						3-4 or 4-3	2X	3.4
	46	26 sec.	106.2	10 ft.	23	1-4-2-3 or 2-3-1-4	11X	25.4
	52	38 sec.	82.1	10 ft.	15.8	1-4-2-3 or 2-3-1-4	11X	17.4
						3-4 or 4-3	2X	3.2
Mean	50	33 sec.	90.9	10 ft.	18.2	1-4-2-3 or 2-3-1-4	11X	20
						3-4 or 4-3	2X	3.6

Performance Data for Gary

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Session	Total Steps	Total Duration	Rate Steps/Min.	Distance	Rate Dist./Min.	Patterns Occurring 2X or More	Frequency of Pattern	Rate Pattern Freq./Min.
1	36	120 sec.	18	10 ft.	5	1-4-2-3 or 2-3-1-4	9X	4.5
	44	120 sec.	22	10 ft.	5	1-4-2-3 or 2-3-1-4	11X	5.5
	56	96 sec.	35	10 ft.	6.3	1-4-2-3 or 2-3-1-4	14X	6.3
Mean	45	112 sec.	24	10 ft.	5.4	1-4-2-3 or 2-3-1-4	11X	5.9
2	45	25 sec.	108	10 ft.	24	1-4-2-3 or 2-3-1-4	36X	86.4
	52	48 sec.	65	10 ft.	12.5	1-4-2-3 or 2-3-1-4	13X	16.3
	40	25 sec.	96	10 ft.	24	1-4-2-3 or 2-3-1-4	10X	24
Mean	46	33 sec.	83.6	10 ft.	18.2	1-4-2-3 or 2-3-1-4	20X	36.4
3	36	17 sec.	127	10 ft.	35.3	1-4-2-3 or 2-3-1-4	9X	31.8
	35	18 sec.	116.7	10 ft.	33.3	1-4-2-3 or 2-3-1-4	8X	26.7
	40	28 sec.	85.7	10 ft.	21.4	1-4-2-3 or 2-3-1-4	10X	21.4
Mean	37	21 sec.	105.7	10 ft.	28.6	1-4-2-3 or 2-3-1-4	9X	25.7
4	32	14 sec.	137.1	10 ft.	42.9	1-4-2-3 or 2-3-1-4	8X	34.3
	30	13 sec.	138.5	10 ft.	46.2	1-4-2-3 or 2-3-1-4	7X	32.3
	30	14 sec.	128.6	10 ft.	42.9	1-4-2-3 or 2-3-1-4	7X	30
Mean	31	14 sec.	132.9	10 ft.	42.9	1-4-2-3 or 2-3-1-4	7X	30

Performance Data for David

M(C)72

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE STANDING AND SITTING BEHAVIORS AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results with One Nonhandicapped and Five Handicapped Children[1]

by

Eileen Luddy

and

Donna Lehr

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[1] The procedures and data reported in this study were taken from a Master's thesis conducted by Eileen Luddy that was submitted to the Department of Special Education, University of Kansas, in August 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in Pages M(S) 1 to M(S) 21 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring standing and sitting from a chair with and without a table and standing and sitting from and to the floor were developed.

Standing From a Chair- With a Table

The child was initially placed in a chair determined to be the appropriate size for him. The chair was placed on a 3 feet by 3 feet grid marked off into 3 inch squares. The child was then placed in front of an appropriate table on which was placed another grid of the same size.

After presenting the child with verbal or physical prompts as was needed, observations were made of placement of hands and feet in relationship to the grid, position of the feet, position of the knees, and the adjustment of the trunk during standing. The time it took for the child to stand was also recorded.

The duration measure was begun after presentation of the verbal or physical prompt and terminated after the child stood for two seconds. The remaining behaviors were recorded after the child stood for two seconds.

Standing from Chair-Without Table

The child was initially placed in a chair determined to be the appropriate size for him. The chair was placed on a grid which measured 3 feet by 3 feet and was marked off into 3 inch squares.

After the child was presented with appropriate cues, observations were made of behaviors associated with standing from a chair without support. Behaviors observed included the placement of the child's hands, the position of the legs, the placement and position of the feet in relationship to the grid and the length of time it takes the child to attain the standing position.

The duration measure was begun after the cues were presented and was terminated after the child had remained standing for two seconds. The other behaviors associated with standing were recorded after the child had stood for two seconds.

Sitting in a Chair From Standing-With a Table

The child was initially placed in a standing position at a table determined to be the appropriate size for him. An appropriate size chair was placed a few inches behind the child.

After presenting the child with verbal or physical prompts as needed, observations of the placement of the buttocks on the seat of the chair, the extension of the arms, placement of the hands, placement of the feet and positioning of the trunk were made. The time it took for the child to sit in the chair was also recorded.

The duration measure began after the verbal or physical prompts were presented, and terminated when the child was sitting for two seconds. The remaining behaviors were observed and recorded after the child was sitting for two seconds.

Sitting in a Chair from Standing-Without a Table

The child was initially placed in a standing position with an appropriate sized chair behind him.

After presenting the child with verbal or physical prompts as needed, observations of the position of the hands, placement of the buttocks on the seat, flexion at the knees, and position of the feet were made. The time it took the child to sit in the chair was also recorded.

The measures of duration began after presentation of the verbal or physical prompt, and terminated after the child was sitting for two seconds. The remaining behaviors were recorded after the child was sitting for two seconds.

Standing From the Floor-Without Support

The child was initially placed on the floor in either a long sitting or ring sitting position in the middle of a grid measuring 3 feet by 3 feet which had been marked off into 3 inches squares. The area was clear of any type of materials which might be used to assist the child in standing.

After presenting a verbal or physical cue observations were made of the use or non-use of the hands, the placement of the hands (if used in relationship to the child's body) the position and placement of the feet in relationship to the grid, and adjustment of the trunk after standing. The time it took for the child to attain a standing position was also observed.

The duration measure was begun after presentation of the prompts and was terminated after the child stood for two seconds. The remaining behaviors were observed and recorded after the child remained standing for two seconds.

Sitting to the Floor-Without Support

The child was initially placed in a standing position.

After presenting the child with verbal or physical prompts as needed, observations of the position of the hands, flexion at the knees, and position of the feet. The time it took the child to sit was also recorded.

The duration measure began after the verbal or physical prompt, and terminated after the child was sitting for 2 seconds. The remaining behaviors were recorded after the child was sitting for 2 seconds.

Subjects

This study included five handicapped children and one nonhandicapped child. The handicapped children were students from The University Medical Center Multiply Handicapped Pre-school in Kansas City, Kansas, Swinney Elementary School in Shawnee Mission, Kansas. The criteria for selection were 1) that the subjects demonstrated supported or unsupported standing, and 2) that the subjects could sit in a chair unsupported.

Subject 1. Diane was a five year old severely handicapped female. She had a visual impairment and was mobile by means of creeping. She demonstrated supported standing from the floor, sat in a chair independently and did some cruising. Her tone was described as hypotonic.

Subject 2. Ruth was a five year old severely handicapped female. She was non-ambulatory, pulled to stand from a chair and sat unsupported in a chair. She had slightly below normal muscle tone.

Subject [illegible] Lois was a two year old female who was developmentally delayed, but was acquiring skills in accordance with the normal developmental sequence. When the student began, she was able to pull to stand and cruise. By the time the last assessment was completed (nine weeks), she was walking independently. Her muscle tone was normal.

Subject 4. Rose was a two year old Downs' Syndrome female. She had recently learned to walk independently. Her muscle tone was slightly below normal yet higher than the typical Downs' Syndrome child. She initiated locomotion with her right side and demonstrated hip stability with the left side.

Subject 5. Susie was an eight year old female with cerebral palsy. Her repetoire included independent standing and sitting. She walked independently, but had a noticable gait. Her muscle tone was hypertonic and slightly spastic.

Subject 6. Jim was an eleven month old non-handicapped male. His repetoire of behaviors included independent mobility.

Proceudres for Obtaining Measures of Reliability

The following procedure were used for taking and calculating interobserver agreements for measuring standing and sitting behaviors. Reliability measures were taken from direct observation on five handicpped children and one non-handicapped child. The observers taking the reliability were the author, three graudate students, a former special education teacher, Measures were considered reliable if: 1) reliability scores were no lower than 80% for any one session and 2) 80% criteria had to be met for two consecutive sessions with the same two observers.

Hand and Feet Placement on Grid

The reliability scores for the placement of the hands and feet on the grids were calculated. Grids completed by the observer and examiner were compared for agreements and disagreements. The observers were considered to be in agreement if the following conditions were met: a) X's indicating placement of the child's hand or foot were located in exactly the same square; or b) any portion of the X indicating placement of the child's hand or foot recorded by the observer appeared in the same square as that of the examiner. Observers were considered to disagree if the recorded code for the position shared no common location on the grid.

Body Positions Demonstrated in Standing and Sitting

The number of agreements and number of disagreements were totaled between the two observers for the various positions demonstrated by the child. they were totaled for each session across all trials. The number of agreements was divided by the number of agreements and disagreements, and then multiplied by 100 to obtain reliability scores for each session. The formula was as follows:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + \# of disagreements}} \times 100$$

The mean reliability scores across all sessions for each position was determined by adding together all the reliability scores from each session and dividing by the total number of sessions.

The response time reliability was calculated by dividing the larger time into the smaller time and multiplying that number by 100 using the following formula:

$$\frac{\text{shorter time}}{\text{longer time}} \times 100$$

Results

Reliability

Reliability scores representing percent agreements between observers for each set of measurement procedures are presented for each subject that was involved in the procedures.

Standing from chair-with Table. Table 1 shows reliability scores for three handicapped chidren (Subject 1: Diane; Subject 2: Ruth; Subject 3: Lois) and one nonhandicapped child (Subject 6: Jim). Over all the procedures were reliable with the mean reliability for each behavior across all subjects, all sessions, ranging from 75% to 100%. Grid reliability scores were the lowest ranging from 50 to 100% for individual sessions with the mean for individual students ranging from 75 to 100%.

Standing from Floor -Without Table. Table 2 shows reliability scores for three handicapped children (Subject 3: Lois; Subject 4: Rose; Subject

Table 1

Reliability Scores for Data Sheet #1 (Stand from Floor With Table)

Subject	Session	Reliability Scores per Session										Mean Reliability Scores										Reliability for all Sessions
		Hands		Feet		Knees			Grid		Res.	Hands		Feet		Knees			Grid		Res.	
		R	L	R	L	R	L	Trunk	Hand	Feet	Time	R	L	R	L	R	L	Trunk	H	F	Time	
1	1	75	100	100	75	100	100	100	50	75	100	93	100	87	87	100	100	100	78	84	100	83
	2	100	100	75	75	100	100	100	87	87	100											
	3	100	100	75	100	100	100	100	75	87	100											
	4	100	100	100	100	100	100	100	100	87	100											
2	1	100	100	75	100	100	100	100	87	75	100	100	100	93	81	100	100	87	84	84	100	83
	2	100	100	100	50	100	100	100	75	87	100											
	3	100	100	100	75	100	100	75	87	100	100											
	4	100	100	100	100	100	100	75	87	75	100											
3	1	100	100	100	100	100	100	100	100	87	100	100	100	100	100	100	100	100	93	77	100	97
	2	100	100	100	100	100	100	100	87	62	100											
	3	100	100	100	100	100	100	100	87	75	100											
	4	100	100	100	100	100	100	100	100	87	100											
6	1	100	100	75	100	100	100	100	100	50	100	100	100	88	88	100	100	93	100	75	90	97
	2	100	100	75	75	100	100	75	100	75	90											
	3	100	100	100	75	100	100	100	100	100	100											
	4	100	100	100	100	100	100	100	100	75	100											
*		99		89		100		95	89	80	100	99		90		100		95	84		98	90

*Mean Reliability for all Subjects.

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Table 2

Reliability Scores for Data Sheet #2 (Stand from Chair Without Table)

Subject	Session	Reliability Scores per Session										Mean Reliability Scores										
		Hands R	Hands L	Buttocks	Knees R	Knees L	Trunk	Feet R	Feet L	Grid (Feet)	Time Resp.	Hands R	Hands L	Buttocks	Knees R	Knees L	Trunk	Feet R	Feet L	Grid (Feet)	Res. Time	*
3	1	75	75	100	100	100	100	100	100	100	100	81	81	100	100	100	100	100	100	96	100	89
	2	75	100	100	100	100	100	100	100	87	100											
	3	75	75	100	100	100	100	100	100	100	100											
	4	100	100	100	100	100	100	100	100	100	100											
4	1	100	100	100	100	100	100	100	100	87	100	100	100	100	100	100	100	100	100	90	100	99
	2	100	100	100	100	100	100	100	100	87	100											
	3	100	100	100	100	100	100	100	100	100	100											
	4	100	100	100	100	100	100	100	100	87	100											
5	1	100	100	100	100	100	100	75	100	50	100	100	100	100	100	100	100	75	81	81	100	86
	2	100	100	100	100	100	100	75	75	75	100											
	3	100	100	100	100	100	100	75	75	100	100											
	4	100	100	100	100	100	100	75	75	100	100											
6	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	81	98	98
	2	100	100	100	100	100	100	100	100	75	90											
	3	100	100	100	100	100	100	100	100	100	100											
	4	100	100	100	100	100	100	100	100	50	100											
**		93		100	100		100	94	95	87	99	95		100	100		100	95		87	99	93

*Overall Reliability for all sessions.
**Mean Reliability for all subjects.

5: Susie) and one nonhandicapped child (Subject 6: Jim). The scores indicate that the procedures generally were reliable. Again, the most disagreement occurred in measures of the location of the feet on the grid, with scores ranging from 50 to 100% for individual sessions. The median score, however, was 100%.

Sitting in a Chair from Standing-With Table. Table 3 shows reliability scores for three handicapped children (Subject 1: Diane; Subject 2: Ruth; Subject 3; Lois) and one nonhandicapped student (Subject 6: Jim). Good reliability was obtained on all measures with the mean scores across all sessions for individuals ranging from 86 to 96%.

Sitting in a Chair from Standing-Without Table. Table 4 shows reliability data for three handicapped subjects (Subject 3: Lois; Subject 4: Rose; Subject 5: Susie) and the nonhandicapped child (Subject 6: Jim). Generally the procedure were reliably recorded with mean scores for all behaviors of individual subjects ranging from 91 to 99%. Observations of the position of the feet were least reliable for Subject 5, with scores ranging from 66 to 100%.

Standing from Floor-Without Support. Table 5 shows reliability scores for handicapped subjects 3, 4, 5, and the nonhandicapped child, Subject 6. Mean reliability scores for individual behaviors ranged from 75 to 100%. Excellent reliability was obtained for hand, knees, trunk and time observation. Observations of the feet positions on three out of the 32 observations were 75% or less and for the grid, 25% of the observations had reliability scores of 75% or less.

Sitting to Floor-Without Support. Reliability scores for the behaviors involved in sitting to the floor without support are presented in Table 6. Data for Subjects 3, 4, and 5, and the nonhandicapped children and Subject

Table 3

Reliability Scores for Data Sheet #3 (Sit in Chair from Stand With Table)

Subject	Session	Reliability Scores per Session										Mean Reliability Scores										*
		Knees		Arms		Hands		Feet		Trunk	Time	Knees		Arms		Hands		Feet		Trunk	Time	
		R	L	R	L	R	L	R	L			R	L	R	L	R	L	R	L			
1	1	100	100	100	100	75	75	50	100	100	100	100	100	100	100	94	88	75	94	94	100	93
	2	100	100	100	100	100	100	75	100	100	100											
	3	100	100	100	100	100	100	100	100	75	100											
	4	100	100	100	100	100	100	75	75	100	100											
2	1	100	100	100	100	100	100	100	100	100	100	94	94	94	94	88	94	94	94	100	100	95
	2	100	100	100	100	75	100	100	100	100	100											
	3	75	75	100	100	100	100	100	75	100	100											
	4	100	100	75	75	75	75	75	100	100	100											
3	1	100	100	100	100	100	100	75	75	100	100	100	100	100	100	94	100	82	82	100	100	96
	2	100	100	100	100	75	100	100	75	100	100											
	3	100	100	100	100	100	100	100	75	100	100											
	4	100	100	100	100	100	100	75	75	100	100											
6	1	100	100	100	100	100	100	100	100	100	100	100	100	88	88	88	94	100	100	100	98	86
	2	100	100	75	75	100	100	100	100	100	90											
	3	100	100	100	100	50	100	100	100	100	100											
	4	100	100	75	75	100	75	100	100	100	100											
**		98		95		84		87		98	99	99		96		93		90		99	99	93

*Overall Reliability for all sessions
**Mean Reliability for all subjects

Table 4

Reliability Scores for Data Sheet #4 (Sit in Chair from Stand Without Table)

Subject	Session	Reliability Scores per Session									Mean Reliability Scores									
		Hands		Buttocks	Knee		Feet		Trunk	Time	Hands		Buttocks	Knees		Feet		Trunk	Time	*
		R	L		R	L	R	L		Res.	R	L		R	L	R	L			
3	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	94	88	100	100	98
	2	100	100	100	100	100	100	75	100	100										
	3	100	100	100	100	100	100	75	100	100										
	4	100	100	100	100	100	75	100	100	100										
4	1	100	100	100	100	100	100	100	100	100	93	100	100	100	100	100	100	100	100	99
	2	75	100	100	100	100	100	100	100	100										
	3	100	100	100	100	100	100	100	100	100										
	4	100	100	100	100	100	100	100	100	100										
5	1	100	100	100	100	100	75	75	75	100	100	100	100	100	100	66	81	81	100	91
	2	100	100	100	100	100	75	75	100	100										
	3	100	100	100	100	100	50	75	100	100										
	4	100	100	100	100	100	75	100	100	100										
6	1	100	100	100	100	100	100	100	100	100	100	81	100	100	100	100	100	100	90	98
	2	100	100	100	100	100	100	100	100	100										
	3	100	75	100	100	100	100	100	100	100										
	4	100	100	100	100	100	100	100	100	80										
**		98		100	100		90		98	99	97		100	100		91		95	97	96

*Overall Reliability for all Sessions.
**Mean Reliability for all subjects.

M(S)12

Table 5

Reliability Scores for Data Sheet #5 (Stand from Floor Without Support)

Subject	Session	Reliability Scores per Session									Mean Reliability Scores									*
		Hands R	Hands L	Knees R	Knees L	Feet R	Feet L	Trunk	Grid	Time Res.	Hands R	Hands L	Knees R	Knees L	Trunk	Feet R	Feet L	Grid	Time Res.	
3	1	75	75	100	100	100	100	100	100	100	88	94	100	100	100	100	100	100	100	98
	2	75	100	100	100	100	100	100	100	100										
	3	100	100	100	100	100	100	100	100	100										
	4	100	100	100	100	100	100	100	100	100										
4	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100	100	100										
	3	100	100	100	100	100	100	100	100	100										
	4	100	100	100	100	100	100	100	100	100										
5	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	87	100	87	100	97
	2	100	100	100	100	50	100	100	50	100										
	3	100	100	100	100	100	100	100	100	100										
	4	100	100	100	100	100	100	100	100	100										
6	1	100	100	100	100	100	100	100	50	100	100	100	100	100	100	100	88	75	95	86
	2	100	100	100	100	100	75	100	75	80										
	3	100	100	100	100	100	75	100	100	100										
	4	100	100	100	100	100	100	100	75	100										
**		98		100		97		100	91	99	98		100		100	97		91	91	95

*Overall Reliability for all sessions
**Mean Reliability for all subjects

M(S)13

Table 6

Reliability Scores for Data Sheet #6 (Sit to Floor Without Support)

Subject	Session	Reliability Scores Per Session Hands R	Hands L	Knees R	Knees L	Feet R	Feet L	Time	Mean Reliability Scores Hands R	Hands L	Knees R	Knees L	Feet R	Feet L	Time	*
3	1	75	50	100	100	100	100	100	63	69	88	100	88	94	100	86
	2	50	75	75	100	75	75	100								
	3	75	75	75	100	75	100	100								
	4	50	75	100	100	100	100	100								
4	1	75	100	100	100	100	100	100	87	100	93	93	100	100	93	95
	2	100	100	100	100	100	100	100								
	3	75	100	100	100	100	100	100								
	4	100	100	75	75	100	100	75								
5	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100								
	3	100	100	100	100	100	100	100								
	4	100	100	100	100	100	100	100								
6	1	100	100	100	100	100	100	100	100	100	100	100	100	100	91	99
	2	100	100	100	100	100	100	100								
	3	100	100	100	100	100	100	80								
	4	100	100	100	100	100	100	85								
**		88		94		98		96	90		97		98		96	95

*Overall Reliability for all sessions
**Mean Reliability for all Subjects

M(S)14

6, the nonhandicapped child are presented. Mean reliability for each behavior observed ranged from 63 to 100%. Observations were least reliable for Subject 3 with mean scores ranging from 63 to 100% for this subject.

Discussion

The data indicate that generally the procedures developed reliably measure behaviors involved in the assumption of a standing position from a chair (with and without a table for support) and from the floor as well as the attainment of a sitting position from a chair and to the floor. Limitations, however, exist for some specific procedures.

The placement of the child's hands and feet during the attainment of a standing position were not consistently measured reliably. Alternative procedures must be identified which can be effective. Such a modification should be responsive to changes in hand and foot positions as a child initially stands and subsequently becomes stabilized. Written considerations must be made for the location of the observer enabling an unobstructed view of the grid and child.

THE DEVELOPMENT OF QUANTITATIVE PROCEDURES TO MEASURE STANDING AND WALKING BEHAVIORS AMONG HANDICAPPED AND NONHANDICAPPED INFANTS AND CHILDREN

Interobserver Reliability Results with One Nonhandicapped and Five Handicapped Children[1]

by

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and

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[1] The procedures and data reported in this study were taken from a Master's thesis conducted by Melinda Shephard that was submitted to the Department of Special Education, University of Kansas, in September, 1980.

Overview of Measurement Procedures

A complete description of the measurement procedures used in this study is found in pages M(W)1 to M(W)21 of Volume I, Assessment Procedures for Selected Developmental Milestones. Procedures for measuring pulling to stand, standing and walking were developed.

Pulling to Stand

In measuring this behavior the child was placed approximately one foot from the equipment used in the assessment, i.e., crib, bar, table. Any position such as the creeping position, tall kneeling or sitting was acceptable. The child's hand(s) were placed on the equipment used which was at a specifically recommended height for both the bar and table. When using the crib, the child's hands were placed slightly higher than the child's shoulders.

The behaviors observed were those related to the attainment of a standing position by a child seated on the floor within a 30 second trial. Measures were recorded of the leg movements used in attaining the position-either a half kneel or extended legs. The length of time required to complete the process was also recorded.

Standing

Initial positioning for standing involved the trainer placing the child in a standing position. The child was either placed with his hands resting on the table, given both of the trainer's hands for support or placed in standing while the trainer slowly removed all support. Standing and the corresponding movements that occured in the position were observed: Standing measures included the length of time the child remained standing within the two minute trials; the flexion or hyper-extension of the lower extremities was recorded;

and the width of the base of support was traced. The measures taken of movement in the position consisted of 1) marking the occurence of bounces utilizing partial interval time sampling and 2) the continuous counting of steps made both up and down and sideways. All measures were taken for two minute trials.

Walking

To begin the trial the child was placed standing with his toes on the tape placed on the floor. One, two or no hands for support were provided to the child depending upon prior observations of the child regarding the amount of assistance needed in walking.

The behavior of walking, measured in relationship to the amount of assistance provided to the child included the number of steps taken. This was calculated by counting the steps observed during a two minute time period. Distance was recorded by measuring the distance from the child's starting point to the stopping point it was for the two minute trial which was marked by a piece of tape. Duration of walking was recorded, if less than the total duration of the trial (two minutes). The position of the child's wrists in relationship to his body was recorded at the beginning of the trial for independent walking. After all trials were completed the average stride length was calculated by dividing the distance traveled by the child by the number of steps taken for each trial.

Subjects

For this study, four multiply handicapped students from the Kansas City Regional Center, in Kansas City, Missouri, and one from the Wyandotte County Special Education Cooperative, Kansas were used. Additionally, one non-handicapped child was included. The students were selected on the basis of the presence of the skill being measured in the students' repetoire, while that skill was not fully mastered.

Subject 1. Eric was a 2 year, 6 month old Down's Syndrome male. He was able to pull to a standing position, stand unsupported briefly and take a few steps forward independently.

Subject 2. Sara was a 2 year old female diagnosed as brain damaged. She was able to pull to stand, stand unsupported farily well and walk independently for a few feet. She walked well with one hand held.

Subject 3. Mike was a 2 year, 5 month old male. He was disgnosed as brain damaged with cerebral palsy. He was pulling to stand with a variety of equipment. Mike stood well with both hands held but only briefly with one hand held. He also walked for a few feet with both hands held but only one or two steps with one hand held.

Subject 4. Jay was a 6 year old athetoid cerebral palsy male with severe developmental delay. He was just beginning to pull to stand and to cruise around a table. Jay could stand briefly with two handed support.

Subject 5. Taylor was a 3 year, 2 month old male with severe developmental delay. He was able to walk a few feet with two hands held. He was not able to pull to stand or stand without support.

Subject 6. Arin was a normal developing eleven month old female. She was able to pull to stand and would cruise around furniture. She could stand independently and walk for a few feet.

Procedures for Obtaining Measures of Reliability

The following procedures were used for taking and calculating inter-observer agreements for measuring pulling to stand, standing and walking.

Reliability measures on the multiply handicapped subjects were taken from direct observation in the classroom. The non-handicapped subject was observed at home.

Observers participating in reliability measurements on the multiply handicapped subjects and non-handicapped subject included the investigator, one physical therapist and a special education teacher.

Pulling to Stand

Reliability measures were computed for leg positions and attainment of standing within the specified time by using the following formula:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \quad \text{X} \quad 100$$

This represents the number of agreements divided by the number of agreements plus the number of disagreements multiplied by one hundred. The reliability scores for each trial were then added together and divided by the total number of trials to obtain the mean reliability score for each session. This procedure was repeated for each observational condition (i.e., apparatus used to obtain standing).

Standing

Reliability measures were taken directly from observations of children while standing. Reliability measures were computed for observations of bouncing, stepping and the position of the lower extremities by using the following formula:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \quad \text{X } 100$$

This represents the number of agreements divided by the number of agreements plus the number of disagreements multiplied by 100. The reliability scores for the duration of standing were calculated by using the following formula:

$$\text{Percent reliability for duration} = \frac{\text{smaller duration}}{\text{larger duration}} \times 100$$

The reliability scores for each trial were then added together and divided by the total number of trials to obtain the mean reliability scores for each session. This procedure was used for independent and supported standing conditions.

Walking

Reliability measures for the number of steps taken, the distance traveled, and the duration the child walked were computed by using the following formula:

$$\frac{\text{smaller \#}}{\text{larger \#}} \times 100$$

This represents the smaller number of measurement divided by the larger number of measurement and multiplied by 100.

Agreement in observing the position of the child's wrist was calculated using the following:

$$\frac{\text{\# of agreements}}{\text{\# of agreements + disagreements}} \times 100$$

The reliability scores for each trial were then added together and divided by the total number of trials to obtain the mean reliability scores for each session.

Results

Reliability scores representing percent agreements between observers for each of the positions are presented in this seciton. The percents for behaviors involved in pulling to stand, standing and walking are shown for each subject that was involved in the procedures.

Pulling to Stand

Table 1 shows reliability scores for the three handicapped children (Subject 1: Eric; Subject 2: Sara; and Subject 3: Jay) and one nonhandicapped infant (Subject 6: Amy). These data show excellent agreement for the position of the legs and the time to attain a standing position.

Standing

Reliability scores between observers for the standing with assistance are presented in Table 2 for the three handicapped children (Subject 1; Subject 2; and Subject 3: Mike). These scores reflect percent agreements for duration of standing, bouncing and stepping measurement procedures. Again, mean reliability scores remain excellent, ranging from a mean reliability of 96% agreement for Subject 3 on the stepping sideways measurement proceudre to 100% mean agreement for all measurement procedures used with Subject 2.

Table 3 presents reliability scores for standing independently from two handicapped children (Subjects 1, and 2, and one non-handicapped child, Subject 6). Mean reliabilities all remain above 92%, for each of the three children across all session. Individual reliability scores for individual sessions range from 66% to 100%.

Walking

Table 4 presents reliability scores for behaviors observed in walking for three handicapped children (Subject 1, 2, and 5) and one non-handicapped child (Subject 6). Mean reliability scores across all sessions ranged from 97% to 100%.

Discussion

While the data indicate that the procedures developed reliably measure behaviors involved in the 1) attainment of standing, 2) standing

TABLE 1

Reliability Scores for Pulling to Stand

Data Sheet #1

		Reliability per Session			Mean Reliability for all sessions			Total Mean Reliability
Subject	Session	Crib	Bar	Table	Crib	Bar	Table	
1	1	100	100	100	100	100	100	100
	2	100	100	100				
	3	100	100	100				
	4	100	100	100				
2	1	100	100	100	100	100	100	100
	2	100	100	100				
	3	100	100	100				
	4	100	100	100				
4	1	100	100	100	100	100	100	100
	2	100	100	100				
	3	100	100	100				
	4	100	100	100				
6	1	100	100	100	100	100	100	100
	2	100	100	100				
	3	100	100	100				
	4	100	100	100				
Mean Reliability for all Subjects		100	100	100				

TABLE 2

Reliability Scores for Standing with Assistance

Data Sheet #2

		Reliability per Session				Mean Reliability for all Sessions				Total Mean Reliability
Subject	Session	Side-Steps	Up/Down Steps	Bounces	Duration	Side-Steps	Up/Down Steps	Bounces	Duration	
1	1	98	100	100	100	100	100	100	100	100
	2	100	100	100	100					
	3	100	100	100	100					
	4	100	100	100	100					
2	1	100	100	100	100	100	100	98	100	100
	2	100	100	100	100					
	3	100	100	92	100					
	4	98	100	100	100					
3	1	100	100	100	100	100	100	100	96	99
	2	100	100	100	83					
	3	100	100	100	100					
	4	100	100	100	100					
6	1	100	100	100	100	100	98	97	100	99
	2	100	94	87	100					
	3	100	100	100	100					
	4	99	100	100	100					
Mean Reliability for all Subjects		100	100	99	99					

TABLE 3

Reliability Scores for Standing Independently

Data Sheet #2

		Reliability per Session		Mean Reliability for all Sessions		Total Mean Reliability
Subject	Session	Duration	Lower Extremeties	Duration	Lower Extremeties	
1	1	100	100	92	100	96
	2	66	100			
	3	100	100			
	4	100	100			
2	1	100	100	100	100	100
	2	100	100			
	3	100	100			
	4	100	100			
6	1	100	100	92	100	96
	2	66	100			
	3	100	100			
	4	100	100			
Mean Reliability for all Subjects		94	100			

M(W)10

TABLE #4

Reliability Scores for Walking

Data Sheet #3

		Reliability per Session				Mean Reliability for all Sessions				Total Mean Reliability
Subject	Session	Steps	Distance	Duration	Wrists	Steps	Distance	Duration	Wrists	
1	1	100	100	89	100	100	97	90	100	97
	2	100	89	83	100					
	3	100	100	100	100					
	4	100	100	89	100					
2	1	100	100	100	100	98	99	97	100	99
	2	100	100	90	100					
	3	100	100	100	100					
	4	90	96	98	100					
5	1	100	100	97		96	100	96		97
	2	93	100	100						
	3	100	100	89						
	4	92	100	100						
6	1	100	100	100	100	99	100	99	100	100
	2	94	100	97	100					
	3	100	100	100	100					
	4	100	100	100	100					
Mean Reliability for all Subjects		98	99	96	100					

M(W)11

and 3) walking, there are some limitations of the procedures which must be mentioned. More precise measure should be obtained of the positions of the arms used by the child in the supported standing position at the table. Some children were observed to lean forward on their arms while others used only one arm. Neither of these behaviors would be recorded in with these observation procedures. The use of a grid on the floor and table would enable the measurement of the base of support provided for the child for himself with his arms and legs. An observer could record the locations in the grid that the hands and feet were placed giving a measure of the distance between the hands or the legs.

Additional measurement procedures are needed for other behaviors associated with standing and walking. Measures for independent attainment of standing from the floor, standing from a chair, sitting to a chair from standing and to the floor from standing are necessary.